TRANSPORT ASSESSMENT

Bristol Arena Island Proposals, Temple Quarter, Bristol

Prepared for

Bristol City Council

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Acronyms and Abbreviations

TA	Transport Assessment
FTEMP	Framework Travel and Event Management Plan
DAS	Design and Access Statement
TRO	Traffic Regulation Order
TTRO	Temporary Traffic Regulation Order
BCC	Bristol City Council
ANPR	Automatic Number Plate Recognition
VMS	Variable Message Sign
TQEZ	Temple Quarter Enterprise Zone
BTM	Bristol Temple Meads
AVSP	Average SCOOT Plan
NPPF	National Planning Policy Framework
SRN	Strategic Road Network
CTMP	Construction Traffic Management Plan
TRADS	'Traffic Data System' - Highways England: SRN Data
GBATS	Greater Bristol Area Transportation Study
PIA	Personal Injury Accident
GWR	Great Western Railway
TPC	Travel Plan Coordinator

SECTION 1

Introduction

1.1 Background

CH2M has been commissioned by Bristol City Council (BCC) to prepare a Transport Assessment (TA) to accompany a Detailed Planning Application for a 12,000 capacity Arena venue situated on the Arena Island site (former Diesel Depot site).

An Outline Planning Application is also sought for other Arena island land uses which comprise 8,200sqm commercial office development (B1 land use class), 1,400sqm commercial A3 / A1 land use classes and 9,400sqm of residential use (C3 land use class). The residential floor-space as described would accommodate 64 two bedroom apartments and 16 one bedroom flats (80 units).

The red line boundary encapsulating the proposals includes the former Diesel Depot site, which is situated within the Temple Quarter of Bristol, a 70 hectare Enterprise Zone (EZ) set up by the government to promote economic development, employment and regeneration.

1.2 Report Purpose

This TA report considers accessibility and the transport impacts of the proposals on the adjoining highway network. It provides the necessary information to assist the local highway authority - BCC in determining the planning application.

This report should be read in conjunction with other transport reports prepared for the planning application submission, namely the Framework Travel and Event Management Plan (FTEMP) and the Design and Access Statements (DAS).

This report has been provided in accordance with policy requirements, namely National Planning Policy Framework (NPPF) and the Highways Agency Circular 02/2013 - "The Strategic Road Network and the Delivery of Sustainable Development."

1.3 BCC Scoping Discussions

A Scoping Study was initially prepared to define the study area and to identify the assessment parameters and key considerations regarding the Arena proposals. The Scoping Study has been discussed in detail with BCC Development Management, who have steered the assessment methodology and parameters adopted. This has been an ongoing process through the preparation of the TA, leading up to the submission of the planning application.

BCC Development Management requested that the TA consider a worst-case traffic scenario in terms of car trip generation and car parking demand, assuming a full capacity (sell out) event occurring during the sensitive weekday and Saturday peak periods. Based on the programme of events identified for the Arena, up to 18-20 full capacity events are anticipated per annum. All other events would attract smaller attendances.

A series of initial business case / transport reports were produced by BCC and partners in the early stages of the Arena's conception and continuing to present day to shape the masterplan proposals. The key findings and conclusions of these reports have been referred to within the TA where appropriate.

The key reports considered include:

- Bristol Arena - Stage 1 Feasibility Report dated 21 September 2012;

- Bristol Arena Parking: Business Case - Preliminary Analysis and Discussion (Arup) - Sept 2013
- Bristol Arena and TQEZ Parking Study (Version 2) dated 18th November 2013; and
- Diesel Depot site - Public Realm and Infrastructure Framework Appraisal dated March 2014.

A copy of the Stage 1 Feasibility Report discussing the need, viability and optimal size of an Arena in Bristol, including the probable catchment area, is included in **Appendix A**. The catchment information has been instrumental in shaping the assumed visitor trip distribution used in the Transport Assessment and hence the expected traffic impact on different approach routes to the City Centre with events of different size.

1.4 Arena Operator Discussions

During the time of preparing the TA, an Arena operator has been appointed for the venue and has provided clarification on how the venue is likely to operate. The TA has therefore been responsive to this appointment, and where possible, has tailored the assessment to the specific operation envisaged for the Bristol Arena.

Information received from the Arena operator included:

- The Arena will hold approximately 20 concerts at the 12,000 capacity level. Other concerts / events will be from 3,000 upwards and will take place 7 days per week, typically between 1930-2300hrs in no particular pattern;
- No other events would typically be held on the same day as the largest 12,000 capacity shows, which could be held on any day of the week;
- Between 6 and 12 weekends per annum would include family events during the daytime e.g. Disney on Ice, with 3 shows per day commencing around 1100am. A maximum of 6,000 patrons would attend this type of event;
- For multiple show days, the majority of the staff would be retained for all 3 sessions. There would be some changeover but not significant;
- The catchment area of the Arena will vary due to a number of factors, including where else the artistes are appearing, the nature of the show and the nature of the audience. Weekend or weekday shows could have a range of 60-90% of visitors within a 40 minute car drive of Bristol; and
- In terms of event staff, arrivals at the Arena will be spread from 2 hours before the start of an event and up to 1 hour after start time (to cover the half time interval). For large concerts up to 400 staff will be working, usually arriving 1 hour prior to Arena doors opening. Door opening would be 90 minutes before the event start time. Departure will commence by attendees as a trickle from 15 minutes prior to end of an event, with the Arena largely emptied by 20-30 minutes from the end of an event /concert. Staff departures will be 30-60 minutes after that.

Taking account of the Arena operator comments in conjunction with information on how other UK Arena sites operate, the analysis included in the TA is believed to be a 'good representation' of the proposed venue's operation.

1.5 Report Structure

Following this chapter, the remainder of the report is structured as follows:

- **Chapter 2** includes a review of relevant planning policy related to transport and the Arena proposals;

- **Chapter 3** considers the existing situation in terms of site accessibility, parking supply, highway operation and safety;
- **Chapter 4** describes the development of the baseline S-Paramics highway models subsequently used to consider highway operation in the different assessment periods and results;
- **Chapter 5** identifies committed transport infrastructure for Bristol that will impact on local area accessibility and access to the Arena;
- **Chapter 6** presents the Reference Case modelling taking into account committed infrastructure schemes;
- **Chapter 7** describes the Phase 1 Masterplan proposals in the detailed planning application, and the subsequent Phase 2 developments on Arena Island covered by the outline planning application;
- **Chapter 8** describes expected Arena catchment area, event sizes and the timing of events on particular days. A 'Worst Case' mode split and visitor trip generation for different size events on a weekday and Saturday is then considered. The expected mode split and trip distribution associated with staff trips is also described;
- **Chapter 9** assesses the expected demand for car parking associated with Arena events of various sizes, and the adequacy of existing parking supply;
- **Chapter 10** considers non-event specific mitigation measures proposed to mitigate impacts and/or ensure safe access/egress for visitors. Mitigation in this sense also seeks to achieve improved connectivity to Arena Island and the wider Temple Quarter Enterprise Zone (TQEZ);
- **Chapter 11** presents worst-case highway modelling outputs assuming no 'specific' event mitigation measures are provided beyond those described in Chapter 10;
- **Chapter 12** sets out event-specific mitigation measures necessary, notably for the larger events in the weekday or Saturday late finishing, and considers what advance planning and visitor incentives may be needed within an Event Management Plan (EMP)to discourage car based travel;
- **Chapter 13** presents highway modelling results with event-specific mitigation included for particular scenarios and discusses findings;
- **Chapter 14** identifies likely construction traffic impacts; and
- **Chapter 15** provides a summary of the key findings and conclusions.

SECTION 2

Transport Policy Review

2.1 Introduction

This chapter sets out national, regional and local level policy associated with transport, in the context of the Arena proposals. It also identifies how the Arena proposals respond to these policies.

2.2 Local Policy

2.2.1 The Development Plan

In planning law, the term 'development plan' is used to refer to the collection of local planning policies by which planning applications must be determined. The development plan in force in Bristol is as follows:

- Bristol Core Strategy, adopted June 2011;
- Site Allocations and Development Management Policies, adopted June 2014;
- Bristol Central Area Plan, adopted March 2015;
- Joint Waste Core Strategy (JWCS) March 2011.

Policies specifically relevant to transport and access elements of the proposal are set out under the following sub-headings. As the JWCS does not contain any proposals or policies relevant to the consideration of the proposal, no further reference is made to it.

2.2.2 Bristol Core Strategy

The Bristol Core Strategy (previously referred to as the Bristol Development Framework) was adopted in June 2011.

The Core Strategy sets out BCC's strategic approach to shaping the future of the city. Under the heading *'Our City in 2026'* the authority writes that; *'In our city centre we wish to promote the potential for... creating transport services fit for a dynamic, green and economically-competitive city' and that 'In order to tackle congestion and air pollution, our overarching vision is for a less car dependent city and an emphasis on walking, cycling, buses, rapid transit and rail. New detailed transport plans will be brought forward to develop this vision through to delivery.'*

The Core Strategy sets out the following aims for Bristol:

- A prosperous, cohesive and sustainable city, a regional and green capital which is a great place to live;
- A safe and healthy city made up of thriving neighbourhoods with a high quality of life;
- A city with sustainable economic and housing growth;
- An accessible and digitally connected city with a transport system which meets its needs; and
- A city which reduces its carbon emissions and addresses the challenges of climate change.

Under a title of 'A city of Sustainable Travel', the Spatial Vision states that… *'Transport and development proposals will be integrated, with improved accessibility throughout Bristol. The transport vision for the West of England will be delivered.*

- *New Showcase bus routes will serve wide areas of the city;*

- *A system of rapid transit will be implemented to serve the city and support its areas of growth and regeneration;*
- *Cycle and pedestrian facilities will be developed to contribute to reducing car dependence and encouraging active lifestyles; and*
- *Rail services will be improved*.'

One of the eleven strategic objectives also covers transport as follows:

'8. Improved accessibility and connectivity - improved accessibility and connectivity to and between centres and within the city, to key services and places of work and recreation, with improved quality of life, for residents, businesses and visitors alike. Residents and workers will have a reduced need to travel. Congestion will be managed, public transport and walking and cycling provision improved and streets, pedestrian areas and spaces will be safe'.

Policies of particular note for the Bristol Arena assessment include:

Policy BCS2: Bristol City Centre: Refers to the city centre expanding to cover the former Diesel Depot site, the improved transport systems and connectivity, including new public transport, pedestrian and cycling routes and transport hubs, to be provided up to 2026. It says that street design will give priority to pedestrian access, cycling and public transport and that new development should include measures to secure public access and routes for walking, cycling and public transport, including access to waterfront areas. Opportunities will be taken to reduce the severance of parts of the city centre from neighbouring communities caused by major roads and other physical barriers.

Policy BCS9: Green Infrastructure: This seeks to maintain, protect and enhance the integrity and connectivity of the strategic green infrastructure network (which includes active travel routes for walking and cycling). Opportunities to extend the coverage and connectivity of the existing strategic green infrastructure network should be taken.

Policy BCS10: Transport & Access Improvements: This policy seeks to locate development proposals where sustainable travel patterns can be achieved, with more intensive, higher density mixed use development at accessible centres and along or close to main public transport routes. Proposals should minimise the need to travel, especially by private car, and maximise opportunities for the use of walking, cycling and public transport. Developments should be designed and located to ensure the provision of safe streets and reduce as far as possible the negative impacts of vehicles such as excessive volumes, fumes and noise. Proposals should create places and streets where traffic and other activities are integrated and where buildings, spaces and the needs of people shape the area.

It goes on to say that the council will support the delivery of significant improvements to transport infrastructure to provide an integrated transport system, which improves accessibility within Bristol and supports the proposed levels of development. Along with a series of named schemes, this will include making the best use of existing transport infrastructure through improvement and reshaping of roads and junctions where required to improve accessibility and connectivity and assist regeneration and place shaping, appropriate demand management and sustainable travel measures. Proposals will be determined to reflect the following transport user priorities as set out in the Joint Local Transport Plan a) The pedestrian; b) The cyclist; c) Public transport; d) Access for commercial vehicles; e) Short stay visitors by car; f) The private car. The needs of disabled people will be considered within all of the above headings.

Policy BCS11 Infrastructure and developer contributions: This policy explains that development will provide, or contribute towards the provision of measures to directly mitigate its impact, either geographically or functionally, which will be secured through the use of planning obligations. Infrastructure, facilities and services required to support growth will be secured through a Community Infrastructure Levy (CIL) for Bristol.

Policy BCS21 Quality Urban Design: This policy requires that that development in Bristol should deliver high quality urban design by:

- Promoting accessibility and permeability by creating places that connect with each other and are easy to move through;
- Promoting legibility through the provision of recognisable and understandable places, routes, intersections and points of reference;
- Delivering a safe, usable built environment comprising high quality spaces that integrate green infrastructure; and
- Creating a multi-functional, lively and well-maintained public realm that integrates different modes of transport, parking and servicing.

2.2.3 Site Allocations & Development Management Policies (SADMP)

The SADMP document, adopted in June 2014 does the following:

- Allocates sites for development outside of the central area and identify areas which are protected by planning policies; and
- Sets out policies by which planning applications are determined, most of which are generally applicable to the area covered by the Bristol Central Area Plan as well as the rest of Bristol.

Policies of particular note for this assessment include:

Policy DM1: Presumption in favour of sustainable development: This policy explains that the City Council will always work proactively with applicants jointly to find solutions which mean that proposals can be approved wherever possible, and to secure development that improves the economic, social and environmental conditions in the city.

Policy DM14: The Health Impacts of Development sets out that development should contribute to reducing the causes of ill health, improving health and reducing health inequalities within the city, including through providing good access to health facilities and services.

Policy DM22: Development Adjacent to Waterways explains that development which is adjacent to, or contains, waterways will be expected to maintain, enhance or create suitable public connections adjacent to waterways for walking and cycling and provide suitable public connections from them to the public realm network in the vicinity.

Policy DM23: Transport Development Management sets out the transport criteria by which development will be assessed. This should not give rise to unacceptable traffic conditions and will be expected to provide:

- Safe and adequate access for all within the development and onto the highway network;
- Adequate access to public transport including, where necessary, provision for public transport improvements;
- Transport improvements to overcome unsatisfactory transport conditions created or exacerbated by the development; and
- Pedestrian and cyclist infrastructure, including cycle facilities inside non-residential buildings

Policy DM27: Layout and Form sets out detailed requirements to ensure quality layout, form, pattern and arrangement of streets, open spaces, development blocks, buildings and landscapes. This includes:

- direct, clear, safe and attractive links to existing routes, local and wider services, amenities and facilities including public transport;
- providing inclusive access;

- seeking opportunities for new street linkages where the existing permeability of the area is poor, desire lines exist or where historic routes can be reinstated;
- not prejudicing the existing and future development potential of adjoining sites or the potential for the area to achieve a coherent, interconnected and integrated built form;
- enabling active frontages to the public realm and natural surveillance over all publicly accessible spaces; and
- enabling the provision of adequate appropriate and usable parking and servicing, taking into account its needs and practicalities

Policy DM28: Public Realm sets out in detail how development should create or contribute to a safe, attractive, high quality, inclusive and legible public realm. Development will be expected, amongst other things, to:

- Sensitively integrate and prioritise appropriate levels of movement infrastructure for different modes, including provision for convenient pedestrian and cycle movement;
- Reduce crime and fear of crime by creating a well-surveyed public realm that is well managed and cared for;
- Enable easy, inclusive access into and through the public realm and to buildings that provides adequately for the mobility needs of all users having regard to age, gender and disability; and
- Ensure that any car parking and provision for servicing are appropriate to the context and are sensitively integrated so as not to dominate the public realm.

Shared Spaces will be encouraged in appropriate locations, designed and detailed to encourage low vehicle speeds, create a pedestrian-friendly environment, discourage inappropriate parking and incorporate street furniture and quality planting as an integral part of the proposed design

2.2.4 Central Area Plan (CAP)

The proposal site falls within (but close to the edge of) the boundary of the Central Area Plan (CAP). Local to the proposal site the boundary of the central area is broadly the Bath Road to the west, the Bristol Relief Rail Line to the south and the eastern bank of the River Avon to the east. The CAP sets out how the city centre is intended to develop over a 15 year period.

Policies of particular note for the Arena assessment are as follows:

Policy BCAP23: Totterdown Basin enhancement: This policy explains that development of sites bordering the Totterdown Basin will be expected to contribute, where appropriate, to its enhancement as a fully accessible natural green space with a wildlife function, including provision of pedestrian and cycle links through the area.

Policy BCAP27: Safeguarded transport links and railway land reserves land and routes for the future implementation of transport schemes. This includes the '*Proposed road bridge from Cattle Market Road to the arena site'*.

Policy BCAP28: New interchange facilities states that development of sites adjacent to Temple Meads Station will be expected to deliver improved public transport interchange facilities and new and enhanced walking / cycle routes as part of the development of Bristol Temple Quarter.

Policy BCAP29: Car and cycle parking explains that the schedule of maximum standards for car parking, and minimum standards for cycle parking and disabled car parking for new development in the SADMP will also apply in Bristol City Centre. Wherever possible and appropriate a significantly lower level of provision will be permitted or sought.

Policy BCAP30: Pedestrian routes identifies a network of existing and proposed primary and secondary pedestrian routes. Development on or adjacent to these routes will be expected to provide an appropriate level of public realm improvements to them. Development that would be harmful to the amenity or accessibility of them will not be permitted.

Policy BCAP32: Quayside walkways explains that development on or adjacent to Quayside Walkways (which includes the banks of the tidal River Avon) will be expected to provide or retain a continuous route finished to a high standard of design and development that would be harmful to the amenity or accessibility of them will not be permitted.

Policy BCAP33: Key city spaces explains that development on or adjacent to important city spaces will be expected to provide an appropriate level of public realm improvements having regard to the role and the priorities for each space. Spaces close to the proposed development include *interchange spaces* at Temple Meads Station, *destination spaces* to be created in Bristol Temple Quarter and *waterfront spaces* at Totterdown Basin.

Policy BCAP35: Bristol Temple Quarter explains that sites in this defined area, site KS01, on the policies map will be developed for a wide range of uses including a major indoor arena (up to 15,000 seats), new walking and cycle routes to connect the developments the rest of the city centre and surrounding neighbourhoods and public realm enhancements. Bristol Temple Meads Station will be enhanced as a major transport interchange.

2.3 National Policy

2.3.1 National Planning Policy Framework (NPPF)

NPPF was published in its final form on 27 March 2012 and superseded the series of Planning Policy Guidance Notes, Planning Policy Statements and some Circulars with immediate effect. The NPPF constitutes guidance for drawing up plans, in line with the requirements of section 19(2)(a) of The Planning & Compulsory Purchase Act 2004, and is a material consideration in determining planning applications.

The NPPF upholds the importance of transport in contributing to sustainable development and wider sustainable and health objectives (para 29). Transport solutions should support reductions in greenhouse gas emissions and congestion (para 30).

It states that the transport network needs to be balanced in favour of sustainable modes to give people a real choice about how they travel (para 29). The planning system should, where reasonable to do so, support a pattern of development which facilitates sustainable transport (para 30) and local planning policy should aim for a balance of land uses to encourage people to minimise the length of their journeys to employment, shopping, leisure, education and other activities (para 37).

It recognises that the opportunities to maximise sustainable transport solutions will vary from urban to rural areas and different communities will require different policies and measures (para 29).

Developments that generate significant amounts of movement (a term defined in the DfT document *Guidance on Transport Assessment*) should:

- Be supported by a transport statement or TA (para 32); and
- Have a travel plan prepared (para 36).

Planning decisions should take account of whether significant movement-generating developments will:

- Be located where the need to travel can be minimised and the use of sustainable transport policies can be maximised (para 34); and

- Take up the opportunities for sustainable transport and reduce the need for major infrastructure, depending on the nature and location of the site (para 32);
- Achieve safe and secure access for all people (para 32); and
- Undertake transport network improvements to cost-effectively limit the significant impact of development (para 32).

Applications should only be refused or prevented on transport grounds if the residual cumulative impacts are severe (para 32). Sites identified by the local planning authority for development should not be subject to such a scale of obligations and policy burdens, that their ability to be developed viably is threatened (para 173).

According to para 35, developments should be located and designed to:

- Accommodate the efficient delivery of goods and supplies;
- Prioritise the movement of pedestrians and cyclists;
- Provide access to high quality public transport;
- Create safe and secure layouts which minimise conflicts between motorised traffic, pedestrians and cyclists and establishing home zones where appropriate;
- Avoid street clutter;
- Incorporate facilities for charging electric or other ultra-low emission vehicles; and
- Consider the needs of disabled people in all forms of transport.

Planning policies for larger-scale residential developments should, in particular, promote a mix of land uses on the site to provide opportunities to undertake day-to-day activities, such as work on site and, where practical, key facilities should be within walking distance of most properties (para 38)

Car parking standards are viewed as a local authority matter and, if set, should take into account accessibility, local car ownership, the type, use and mix of land uses on-site, the availability and opportunities for public transport, local car ownership levels and an overall need to reduce high-emission vehicles (para 39).

Transport sites and routes should be protected where there is robust evidence that could be critical in developing infrastructure to widen transport choice (para 41). When planning for ports, airports and airfields not covered by a National Policy Statement account should be taken of meeting business, leisure, training and emergency needs (para 33). Local authorities should develop strategies with the neighbouring authorities and transport providers to provide viable transport infrastructure to support sustainable development, and the growth of ports, airports and other major generators of travel demand (para 31).

2.4 Other Plans and Documents

Other documents can be considered material considerations in the determination of planning applications. The pertinent points from these are briefly set out below.

2.4.1 Community Infrastructure Levy (CIL)

The City Council adopted its CIL charging schedule on 18 September 2012 and brought it into force on the 1st January 2013. The schedule sets out what types of new development are eligible for the levy, and how much planning applicants must pay towards essential infrastructure. It sits alongside the Regulation 123 List, also published on the same date, which prescribes the infrastructure which the authority may apply CIL revenues to. In terms of transport, CIL revenues may be applied to:

- Bus Rapid Transit (Ashton Vale to Bristol Temple Meads and City Centre);
- The South Bristol Link; and
- Bus Rapid Transit (North Fringe to Hengrove).
- Development comprising 100sqm or more of new build floorspace is liable for CIL. The proposed development is considered to fall within the 'other chargeable development' category at a rate of £50/sqm.

2.4.2 Joint Local Transport Plan 3 (JLTP3)

The JTLP3 was published in final form in 2011 and in partnership by the four West of England Authorities. It sets out the transport strategy for the area until 2026. In line with national guidance, the aims include:

- Tackle Climate Change;
- Support economic growth;
- Promote equality of opportunity;
- Contribute to better safety, security and health; an
- Improve quality of life.

The LTP also outlines the programme for major schemes, which a funded competitively from central government. This programme includes:

- The *Greater Bristol Bus Network*, where corridor 3 (Bristol to Bath) and corridor 6 (Bristol to Midsomer Norton) pass the proposed development; and
- The Ashton Vale to Temple Meads MetroBus scheme.

In terms of the proposed development site, the following investment programmers are also relevant:

- Great Western Mainline electrification, leading to the introduction of electric trains and more frequent services to London
- The MetroWest project, with infrastructure proposals to increase the frequency of local train services;
- The Local Sustainable Transport Fund monies secured for sustainable travel and branded as Travelwest; and
- Cycle City Ambition Grant monies secured to improve north-south connections across the River Avon.

2.5 Policy Fit

The Arena Island site is in an urban area, relatively close to the City Centre. It is adjacent to several existing major transport corridors, with significant investment planned for public transport services on road and on rail. The location provides an important opportunity to deliver a development which, in accordance with national and local policy, prioritises sustainable modes of transport.

The site is traversed and edged by routes which are identified as key new walkways to tie into the city's primary pedestrian network at Temple Meads. The development will not prejudice the routes; but rather it will facilitate and enhance them.

As will be described later in this Transport Assessment, the new local linkages created with the build-out of the Arena (Phase 1) and allied development on Arena Island (Phase 2) will help to improve connectivity and accessibility to this site and the wider TQEZ from the south, and notably the adjacent residential areas of Totterdown, Knowle and Windmill Hill. This will also help to resolve, in part, the existing deficiencies in the pedestrian/cycle provision along the A4 Bath Road between the A4/A37 Three Lamps junction and Bath

Bridge Roundabout. There is an aspiration to accommodate a cycle route through the Arena Island site, thus providing an off-road link from the A4 Bath Road via the Harbour Walkway to areas in the north of the City.

As noted above, the proposal site will benefit from the investment to be made in improving the nearby public transport networks, with the MetroBus project a key example. Furthermore the location of the proposed Arena adjacent to Bristol Temple Meads railway station will maximise the opportunity for encouraging visitor rail travel to/from events, and thereby discourage car travel into the City Centre.

SECTION 3

Existing Situation

3.1 Site Location

The Arena Island site is bounded by the A4 Bath Road to the southwest, the River Avon to the north and east, and by the Bristol to Exeter railway lines to the south and west. The site forms part of the wider TQEZ, which consists of a 70 hectare area in the heart of Bristol including Temple Meads Railway Station. **Figure 3.1** shows the location of the site.

The A4 Bath Road to the west of the site is a major arterial traffic route into the City Centre. Just south of the Arena site this route has a major junction with the A37 Wells Road at Three Lamps. This traffic signal controlled junction caters for all movements with the exception of the right turn from the A37.

The St Phillips industrial area is located immediately east of the site, although no connection is provided across the River Avon. Feeder Road and Albert Road provide the primary routes in connecting this area to the principle route of the A4320 St Philips Causeway, which together with Easton Way, provides a strategic connection to the east of the City Centre, connecting the M32 at Junction 3 with the A4 Bath Road at Arnos Vale.

3.2 Site Accessibility

3.2.1 Highway Access

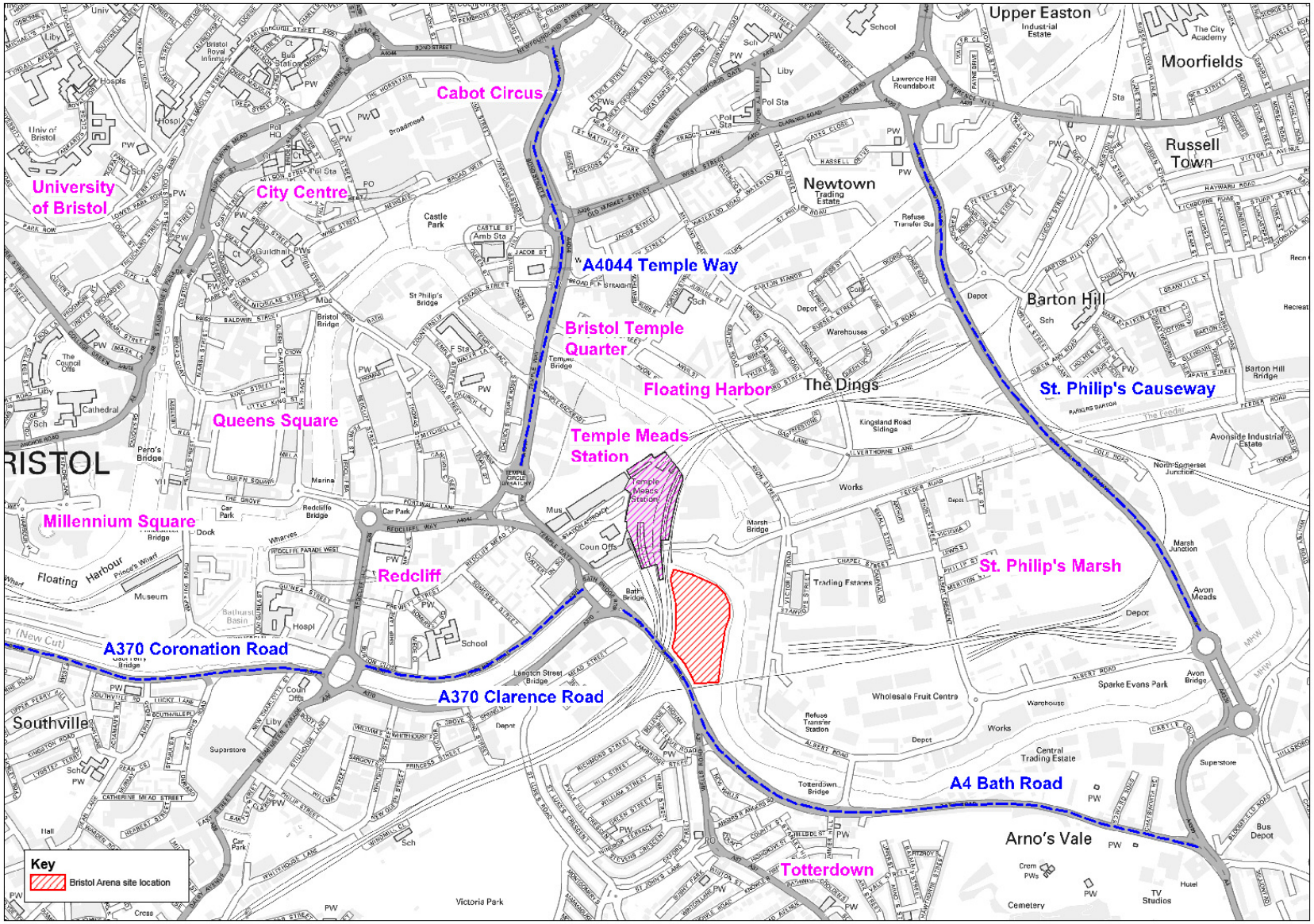
As noted above the A4 Bath Road/Temple Gate is the principal traffic route running close to Arena Island. At Bath Bridge roundabout vehicular access to Arena Island will normally be available from this route in the southbound direction via Cattle Market Road, although as explained later in this Transport Assessment, it is proposed that Cattle Market Road will be closed for large events on a weekday and Saturday evening.

To the south of Arena Island access into the St Phillips industrial area from the A4 Bath Road is provided via Totterdown Bridge in the eastbound direction. The right turn from the A4 to the bridge is prohibited, so access into the St Philips area for traffic travelling into the city on the A4 is obtained via St Phillips Causeway and Albert Road. The latter route skirts the perimeter of the main trading estate and runs along the east side of the Arena Island site, on the opposite side of the River Avon.

The main access route from the north is the A4044 Temple Way (from M32), although driver access via Easton Way/St Phillips Causeway is also possible, with final routing via Days Road and Avon Street. It should be noted that, with limited provision of parking on Arena Island, most car-borne visitors attending events will derive no advantage in driving to the site. As such, a lot of drivers will seek parking in central car parks, which will serve to disperse any concentrated impact of event-generated traffic around the Island itself.

The Arena site currently has a single point of access from the A4 Bath Road (Bath Bridge), via a priority junction with the western side of the carriageway. Access to the site is on a left-in / left out basis, and requires vehicles to cross a designated bus lane. From the site access, the access road loops under the A4 Bath Road to connect to the site. The route is currently gated approximately 10 metres into the access bell-mouth with the A4 Bath Road and again upon entry to the site.

Figure 3.1: Bristol Arena Island - Site location



Over the wider highway network, a series of restrictions can affect access to the site, some of which have been discussed above. These are identified below.

- Height restriction on Cattle Market Road (14'0");
- Height restriction Albert Crescent (14'3");
- Height restriction Avon Street (12'9");
- The railway bridge on Albert Road limits access to over-height vehicles;
- Height restriction Gas Lane (13'3");
- Height restriction Kingsland Road (11'6");
- Height restriction on the existing access from A4 Bath Road;
- No right turn from A4 Bath Road to Totterdown Bridge; and
- There is also a weight restriction in the area.

3.2.2 Pedestrians and Cyclists

3.2.2.1 Audit Findings

A walk/cycle audit has been undertaken for routes surrounding the site in order to provide a comprehensive picture of the existing network and deficiencies in its infrastructure provision. These include routes that will be commonly used to access the Arena site. These connect the Arena to key origin/ destinations such as Bristol Temple Meads Railway Station, residential areas, car parks, bus stops, hotels and the city centre.

The 10, 15 and 20 minute walk isochrone zones around the Arena Island site are shown in **Figure 3.2**, with the wider cycle route network, location of bus stops and the railway station shown in **Figure 3.3.**

Whilst a wide range of route possibilities exist to access the Arena, the primary routes have been considered as part of this Audit, identified to offer either the shortest distance, directness, convenience and/or suitability for larger volumes of pedestrians. The audit is provided in the CH2M document - Diesel Depot site - Public Realm and Infrastructure Framework Appraisal, dated March 2014, included in **Appendix B**. The key findings in respect of existing pedestrian/cycle access to the Arena Island are as follows:

- A series of pedestrian / cyclist constraints exist on the local highway network surrounding the site, in particularly along the A4 Bath Road. Crossings between the Arena site and the city centre are not necessarily provided along desire lines, and would be unsuitable for large volumes of crossing movements. That said, the Temple Gate scheme which is in planning, will seek to address many of these issues and provide enhanced routes and crossing facilities for pedestrians;
- Lighting and footway surfacing has been raised as an issue in several locations;
- St Philips Marsh has an industrial feel and many of the roads surrounding the site have little active frontage. It is not an attractive location for Arena visitors although will undoubtedly improve over time;
- Cattle Market Road, which is a key route between the site and the city centre/railway station, has limited footway provision and is unsuitable for large volumes of pedestrian/cyclist traffic. This issue should be addressed as part of the Temple Greenways scheme currently under construction;
- Limited signage is provided around the Arena site, as these areas are not currently routes that visitors walk when visiting the city; and
- Opportunities should be investigated to improve cycle route provision, to fix damaged kerbs / footways, improve lighting and signage and better link the site to the City Centre and key public transport interchange facilities.

Figure 3.2: Walk zone isochrones around Arena Island

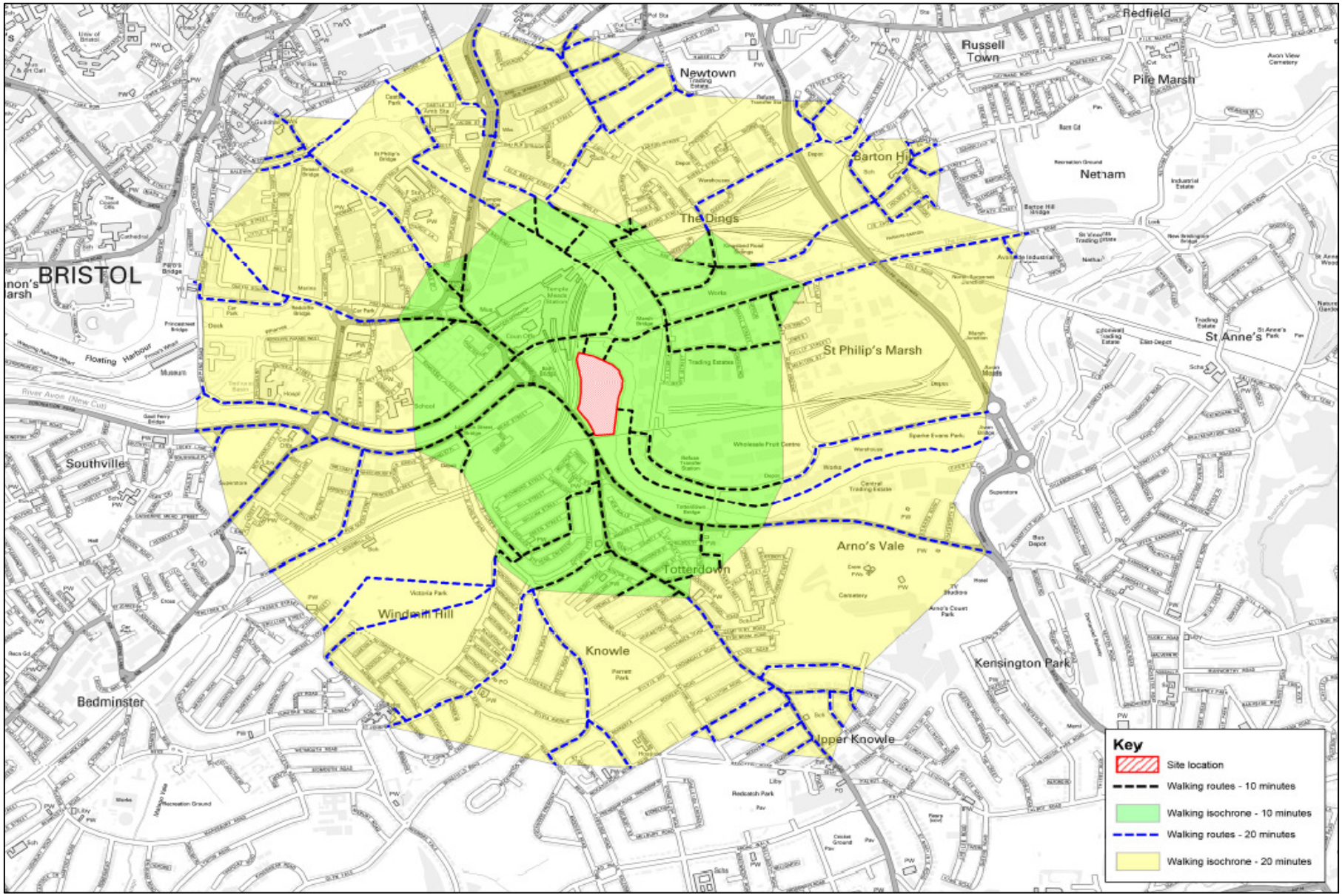
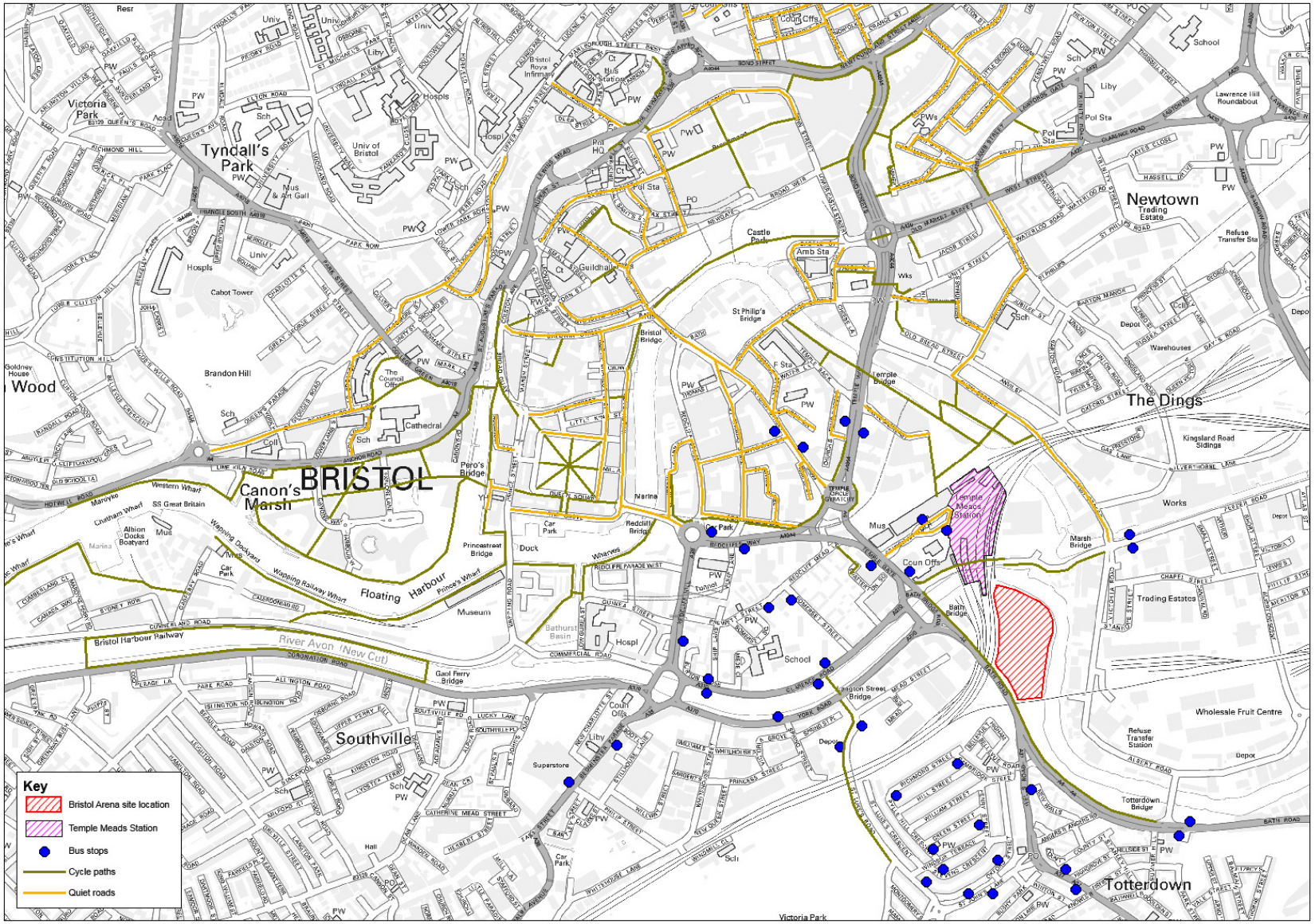


Figure 3.3: Bus stops and cycle routes in the surrounding City Centre area



3.2.2.2 A4 Bath Road Corridor

A key pedestrian/cycle corridor to the west of Arena Island is the A4 Bath Road. The existing east footway along this length of Bath Road is narrow and typically 2m in width. A segregated cycle lane has been marked out on this footway which takes up half of this available width. The existing pedestrian and cycle flows along this footway were surveyed on Thursday 17th September 2015 between 4:00-7:00pm. The recorded flows in each fifteen minute are shown in **Table 3.1** below. In the 5:00-6:00pm peak hour the two-way flow of pedestrians and cyclists was 255 and 123 respectively. As expected at this time of day the flows are predominantly in the outbound or southbound direction to Three Lamps, and critically in the opposite or conflicting direction to the potential flow of visitors towards Arena Island. During the 6:00-7:00pm period the existing demand does drop-off a bit, but two-way pedestrian and cyclist flows are still 180 and 117. It is interesting to note that the cyclist use, which has half the current footway width allocated, is practically un-altered from the 5:00-6:00pm volume. This is testament to the perceived value of this cycle facility.

The level of cycle usage is quite high, so in busy periods pedestrians are effectively confined to an available walk-width of little more than a metre. This makes two-way passage difficult but just about possible without encroachment into the space defined for cyclists. Survey results obtained for the weekday evening peak period do show that pedestrian flow at this time is extremely tidal and southbound. However, this may not remain the case during the expected arrival period for an evening Arena event.

Table 3.1 A4 Bath Road-East Footway - Existing Pedestrian and Cyclist Flows: Thursday 17th September 2015

Time Interval	**Northbound (to City Centre)**		**Southbound (to Totterdown)**	
	Pedestrians	Cyclists	Pedestrians	Cyclists
4:00 - 4:15pm	4	3	12	11
4:15 - 4:30pm	9	1	19	11
4:30 - 4:45pm	7	0	32	17
4:45 - 5:00pm	5	1	25	13
5:00 - 5:15pm	11	1	24	8
5:15 - 5:30pm	8	1	40	35
5:30 - 5:45pm	4	2	75	26
5:45 - 6:00pm	11	0	82	50
6:00 - 6:15pm	11	1	50	32
6:15 - 6:30pm	10	1	41	40
6:30 - 6:45pm	5	0	24	25
6:45 - 7:00pm	7	2	32	16
Totals	**92**	**13**	**456**	**284**

3.2.3 Bus Services

Bus stops positioned to the north of the site on Temple Gate and Station Approach are approximately 300m and 400m walk respectively. The bus stops located on Station Approach share facilities with BTM, sheltered by the station's canopy. Timetable and service information is provided and the area is well maintained and secure, with CCTV coverage. On Temple Gate, two bus stands are provided for travel in both directions and include shelters, seating, service and real time bus information.

To the south of the Arena site, bus stops are located within 400 metres of the site and include well maintained shelters, seating and real time information. Kassel kerbs are provided to aid accessibility for the mobility impaired and for those users with push chairs**. Figure 3.4** shows the location of the nearby bus stops considered further in the analysis. Wider bus service provision in the city centre, forms part of the Greater Bristol Bus Network (GBBN) which comprises 10 strategic routes delivering an 'enhanced commuter experience'. The 10 routes comprising the GBBN are shown in **Figure 3.5.** It should be noted that this figure is not illustrative of the entire bus network in the local area.

An overview of bus services arriving in time for an evening event (between 1700 and 1930) and leaving afterwards in the late evening (2300+) are summarised in **Appendix C**, arranged by bus stop. Due to the central location of the Arena there is a good coverage of services for events taking place during the day and hence they have not been included in the tables. The tables show that there is good service coverage and frequency for visitors arriving by bus between 1700 and 1930, but the service availability after 2300 is much sparser.

In addition to these services which are served by bus stops near to the site, there are a number of late night and 24 hour bus services running from the centre of Bristol, which is approximately a 20 minute walk away from the site. Therefore, these services are also appropriate for Arena travel. The complete list of night services are shown in **Table 3.2**.

Table 3.2: Night bus services in Bristol and last bus times

Service	Operator	Bus Route	Last bus leaving City Centre
2	First	Centre (Colston Aven stop Cd) - Temple Meads - Knowle – Stockwood	0200
6	First	Centre - Lawrence Hill - Soundwell - Kingswood	1250
39	First	Bristol bus station - Temple Meads - Brislington - Keynsham - Saltford - Newton St. Loe - Bath bus station	0200 towards Bath 0100 towards Bristol
40	First	Old Market-Centre - Sea Mills - Shirehampton - Cribbs Causeway	0200
43	First	Centre-Lawrence Hill-St George-Kingswood-(then changes to follow 44 route)-Hanham-St George-Lawrence Hill-Centre	Runs 24 hours (Monday - Saturday)
48	First	Centre-Stapleton Road-Fishponds-Downend	Runs 24 hours (Monday - Saturday)
70	First	Broadmead - Muller Road - Filton Avenue-UWE	0330
73	First	Broadmead - Filton Avenue-Parkway Station - Cribbs Causeway	0205
75/76	First	Cribbs Causeway - Patchway (75) - Filton (75) - Henbury (76) - Southmead (76) - Centre - Bedminster-Withywood (75) - Hartcliffe-Hengrove	Runs 24 hours (Monday – Sunday)
N47	First	Centre - Downend - Coalpit Heath - Yate - Chipping Sodbury	0335
X2	First	Bristol Bus Station - Abbots Leigh - Pill - Portishead	0130

This does provide a better late evening coverage to a wide range of local destinations within Bristol or the wider West of England (WoE) area.

Figure 3.4: Bus stops nearest to the Arena Island site

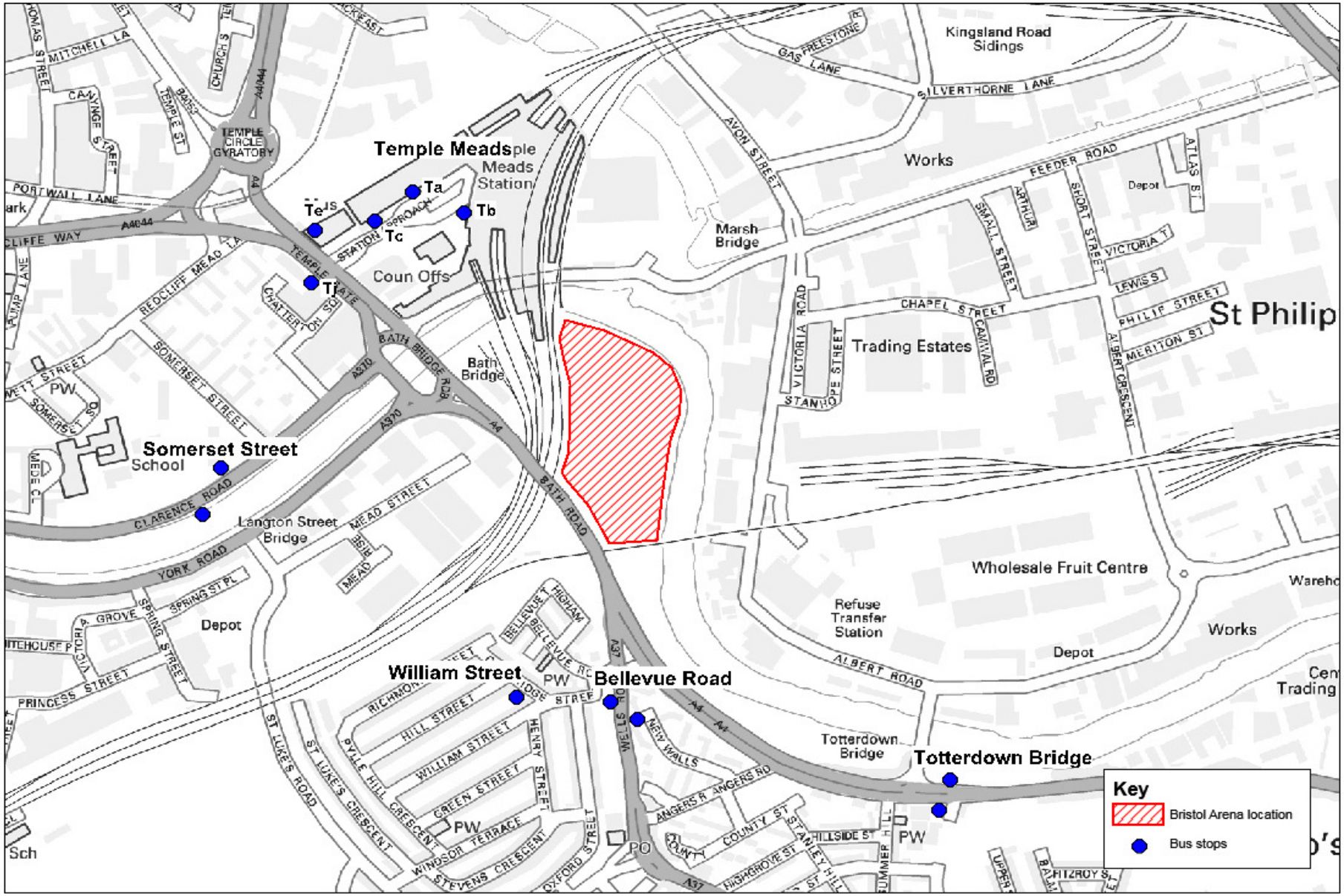
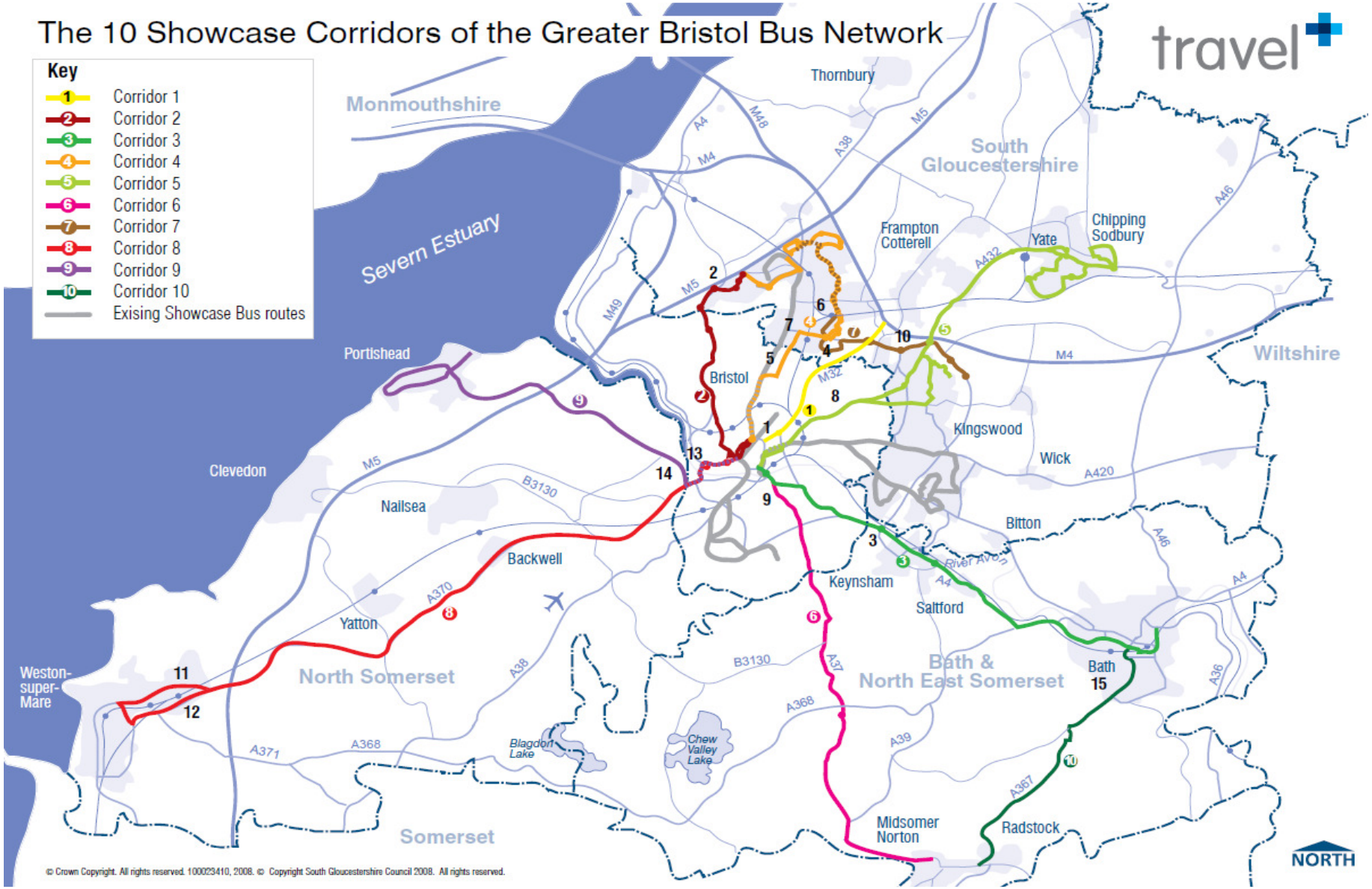


Figure 3.5: The 10 Showcase bus corridors in Bristol (source BCC website)



3.2.4 Park and Ride Services

Bristol currently operates three Park & Ride (P&R) sites, each providing bus services that connect to the City Centre and surrounding locations.

- Portway P&R - The A4 Portway P&R is located on the A4 Portway at Shirehampton; to the northwest of the city and close to M5 Junction 18. This service provides connections to Broadmead and the City Centre. The service operates from Monday to Friday between 0615 and 1925 weekdays and between 0730 and 1850 on Saturdays. There are 500 parking spaces provided;
- Long Ashton P&R - The Long Ashton P&R service provides an approximate 15 minute bus journey time into central Bristol, operating approximately every 12 minutes. The P&R site is located just off the A370 to the southwest of the city, operating from Monday to Friday between 0615 and 1900 weekdays and between 0800 and 1810 on Saturdays. This site provides 1500 parking spaces;
- Brislington P&R - Brislington P&R is located just off the A4 Bath Road in Brislington southeast of the city. Route 904 connects the Brislington P&R site with the City Centre, with buses travelling along the A4 Bath Road. This P&R has 1300 car parking spaces.

The details of these three services are summarised below in **Table 3.3**.

Table 3.3: Bristol Park and Ride services

P&R site	Operator	Buses	Bus freq.	Parking spaces	Weekday last bus	Weekday site closed	Saturday last bus	Saturday site closed
A4 Parkway	CTPlus	902	12-15 mins	500	20:48	21:30	19:00	20:00
Long Aston	First	903	10-12 mins	1500	20:52	21:30	19:04	21:00
A4 Brislington	CTPlus	904	12-15 mins	1300	20:44	21:30	19:09	20:00

An additional Parkway North P&R site (also known as Stoke Gifford) is located by Bristol Parkway Station providing 200 spaces, although this site is served by buses running through the area, rather than having its own designated bus service. Service 73/X73 (which was previously shown as one of Bristol's night services in **Table 3.2**) provides a frequent service between the City Centre and the Parkway North P&R site. It is suitable for late night travel after an evening event.

The details of the bus services between the centre and Parkway North are shown in **Table 3.4.**

Table 3.4: Bus services between Parkway North and the City Centre

Service	Operator	Bus route	Weekday freq.	1700-1930	2300 +	Saturday freq.	1700-1930	2300 +
3B	Wessex	City Centre – Montpelier – Horfield Common – Aztec West – Bradley Stoke – Bristol Parkway – Braydon Avenue – Aztec West	Every 30 minutes (1600-1820 only)	1700, 1730, 1800, 1820	-	No service	-	-
73/X73	First	Centre – Gloucester Road (73) – Filton Avenue (73) – Bristol Parkway Station – Bradley Stoke - Patchway	Every 12 minutes	1704, 1716, 1728, 1742, 1753, 1806, 1816, 1828, 1841, 1852, 1903, 1915, 1926	2305, 2335, 0005, 0105, 0205	Every 15 minutes	1713, 1728, 1743, 1757, 1813, 1829, 1844, 1858, 1913, 1926	2305, 2335, 0005, 0105, 0205

3.2.5 Rail Services

3.2.5.1 Late Evening Coverage

Bristol Temple Meads (BTM) railway station is located approximately 300m (crow fly) to the north of the site, separated by the River Avon and Cattle Market Road.

BTM is owned by Network Rail and operated under franchise by Great Western Railway (GWR). This station offers both strategic train services to London as well as local and inter-urban trains to destinations such as Cardiff Central, Southampton, Portsmouth and Weymouth.

Long distance inter-city trains are operated by Cross-Country to destinations including Exeter St Davids, Plymouth and Penzance in the Southwest; Birmingham New Street in the Midlands; Manchester Piccadilly, Leeds and Newcastle in the North; and Edinburgh, Aberdeen and Glasgow Central in Scotland. A less frequent service to London Waterloo is provided by South West Trains.

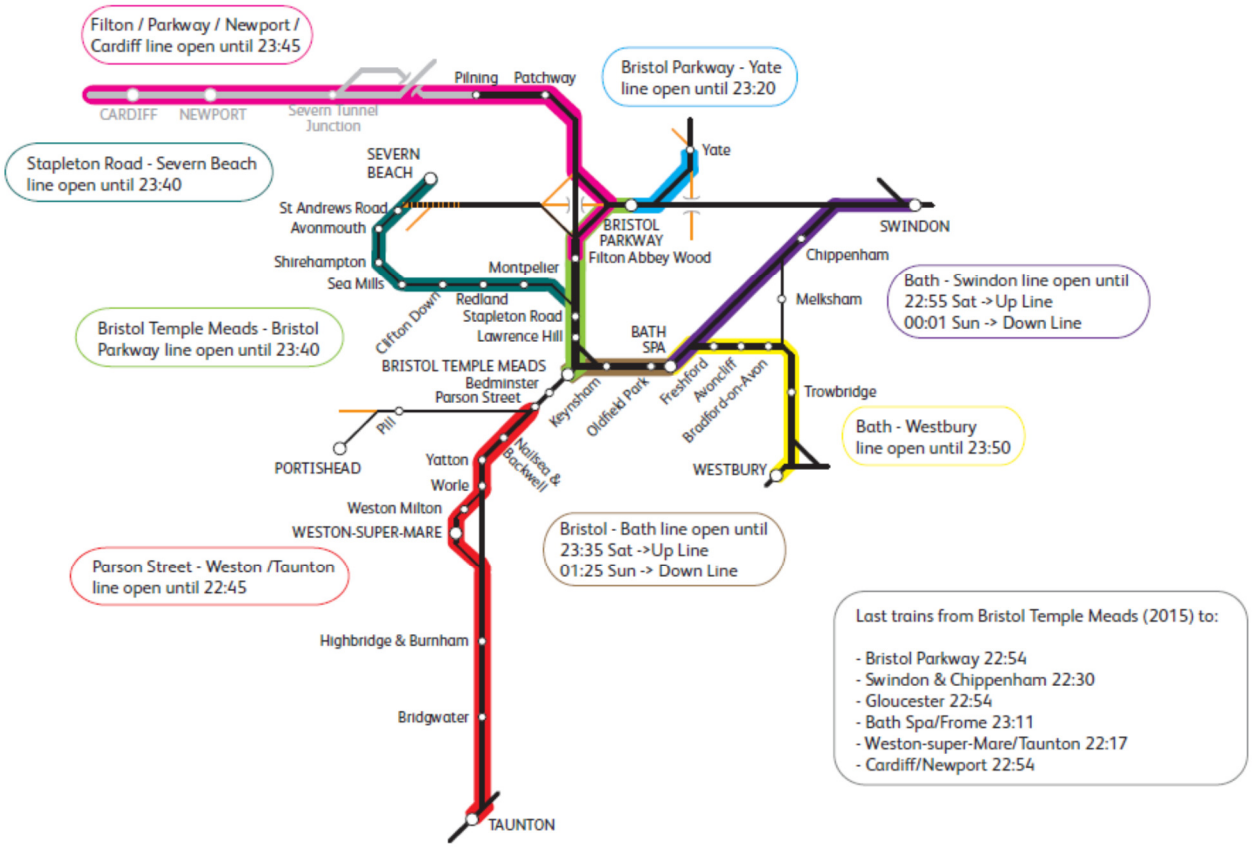
In the case of late evening events finishing between 2230-2300 on a weekday or Saturday, only services departing Bristol Temple Meads railway station after 2300 are realistically able to offer a service to Arena visitors departing via rail. The presently timetabled last direct trains during weekday and Saturday evenings are shown in **Table 3.7** below.

Table 3.7: Last Direct Trains from Bristol Temple Meads Station

	Weekday Periods		Saturday Periods	
Destination	**Depart Temple Meads**	**Arrive Destination**	**Depart Temple Meads**	**Arrive Destination**
Bath Spa	23:20	23:37	23:11	23:27
Bedminster	23:06	23:10	21:59	22:01
Bristol Parkway	22.54	22:23	22:54	22:17
Cardiff	01:37	02:51	22:54	23:55
Clifton Down	22:16	22:29	22:16	22:29
Exeter St. David's	23:35	01:07	22:17	23:47
Frome	23:20	00:19	23:11	00:08
Gloucester	22:54	00:39	22:54	00:38
London Paddington	22:35	00:39	22:30	00:33
Newport	01:37	02:20	22:54	23:35
Plymouth	21:44	23:39	21:44	23:56
Portsmouth	21:23	23:54	21:22	23:53
Swindon	22:35	23:14	22:30	23:19
Taunton	23:35	00:36	22:17	23:17
Warminster	22:23	23:12	22:23	23:12
Westbury	23:20	00:07	23:11	23:57
Weston-Super-Mare	23:35	00:05	22:17	22:47
Weymouth	20:49	23:13	20:49	23:13

The table shows that Saturday evenings are particularly critical. Discussions with Network Rail have revealed that this is because most of the track possessions on the local and intermediate rail network for engineering work take place on a Saturday, with the line between BTM and Parkway taken out of service at 2340. During the weekday the same section is taken over at 2350, but there is generally less possession work affecting the network in the week. This is why the late evening services are better at this time.

Figure 3.6 below shows the existing line closure times on a Saturday provided by Network Rail. As noted above, the BTM to Parkway section is open until 2340, but the time of line closures further afield affect the last possible service to destinations further afield.



3.2.5.2 Existing Capacity

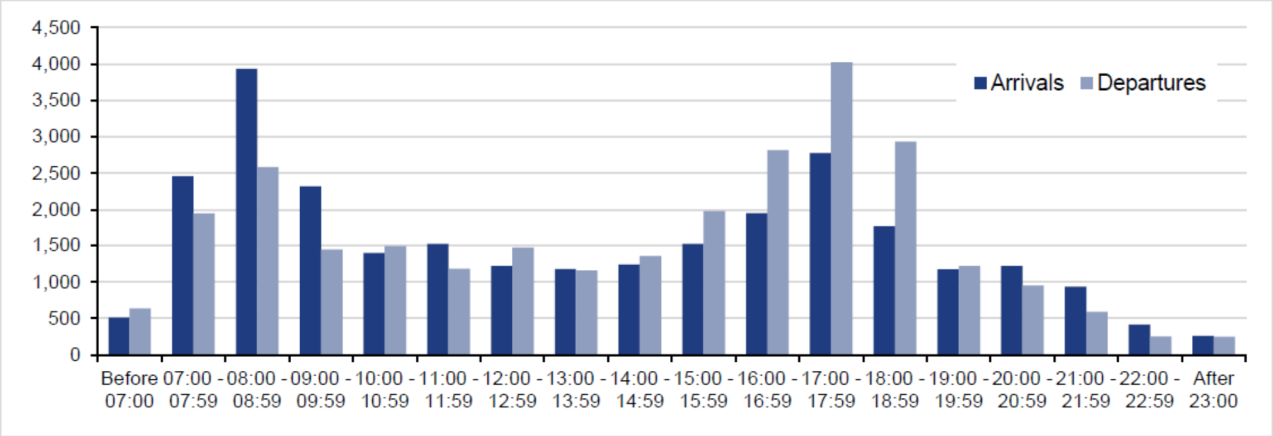
Details of the existing rail service capacities available in the 1600-1900 period preceding a weekday event, and for the whole of a Saturday, are not available from GWR. As such, the only indication of what spare capacity exists in the present rail services serving central Bristol is provided by DoT Rail Executive National Statistics document 'Rail passenger numbers and crowding on weekdays in major cities in England and Wales: 2013', issued in September 2014.

This document uses 'Passengers in excess of capacity (PiXC)' as the main measure of crowding used in these statistics. It shows the proportion of standard class passengers that are above the capacity on their service at its busiest point. The numbers of PiXC on each service are then added together and shown as a percentage of the total number of passengers on all peak services. With respect to a service's capacity, this includes all standard class seats and also includes a standing allowance if passengers are standing for 20 minutes or less.

In the case of Bristol the PiXC figure is 1.2% for the weekday morning peak period (0700-1000), and 0.8% in the afternoon peak period (1600-1900). With respect to Arena visitors the arrivals will impact on 'peak' rail service capacity in the afternoon, rather than in the morning peak period when there will be no discernible

change. Whilst the figures suggest a level of overcrowding on services in the 1600-1900 now, it should be noted that all PM figures are based on all services '*departing from a City Centre terminal in the three hour period from 1600 to 1859*'. As this time of day it would be expected that rail departures and thus passenger occupancy on service outbound from Bristol Temple Meads would be much higher than the occupancy of services inbound to the City Centre.

Figure 3.7 shows an extract from this report showing the typical weekday arrival/departure passenger profile in Bristol in 2013. Figures refer to 'central Bristol', so it is assumed that this is based on passenger loadings surveyed at Bristol Temple Meads.



3.3 Parking Supply

3.3.1 Off-Street Car Parking

3.3.1.1 Car Park Identification

A total of 18 off-street car parks in the City Centre were identified as being potentially usable by Arena visitors, taking account of walk distance and other factors. These include car parks able to accommodate trips associated with events occurring on any of the days and times identified by the Arena operator, which is covered later in this Transport Assessment. For evening events this includes the need for cars to park from 1630 onwards to accommodate early event arrivals, whilst only car parks that remain open on a 24 hour basis, or until midnight have been considered as a viable choice to accommodate an event finish time of 2300 hrs. Given the length of events occurring at the venue, 'short stay' car parking typically allowing a maximum stay of 3 hours has also been excluded.

Car parks deemed suitable for use with Arena events are set out below. These are separated into 'primary' and 'secondary' car parks. Primary car parks include the key public car parks in the City Centre, able to accommodate the largest volumes of cars. These are the well-known and well signed car parks, in locations that will be largely used by longer distance visitors visiting the city for an event who are less familiar with the local network and parking options. The secondary car parks include smaller and less well known public car parks that will be better known to the local population of Bristol.

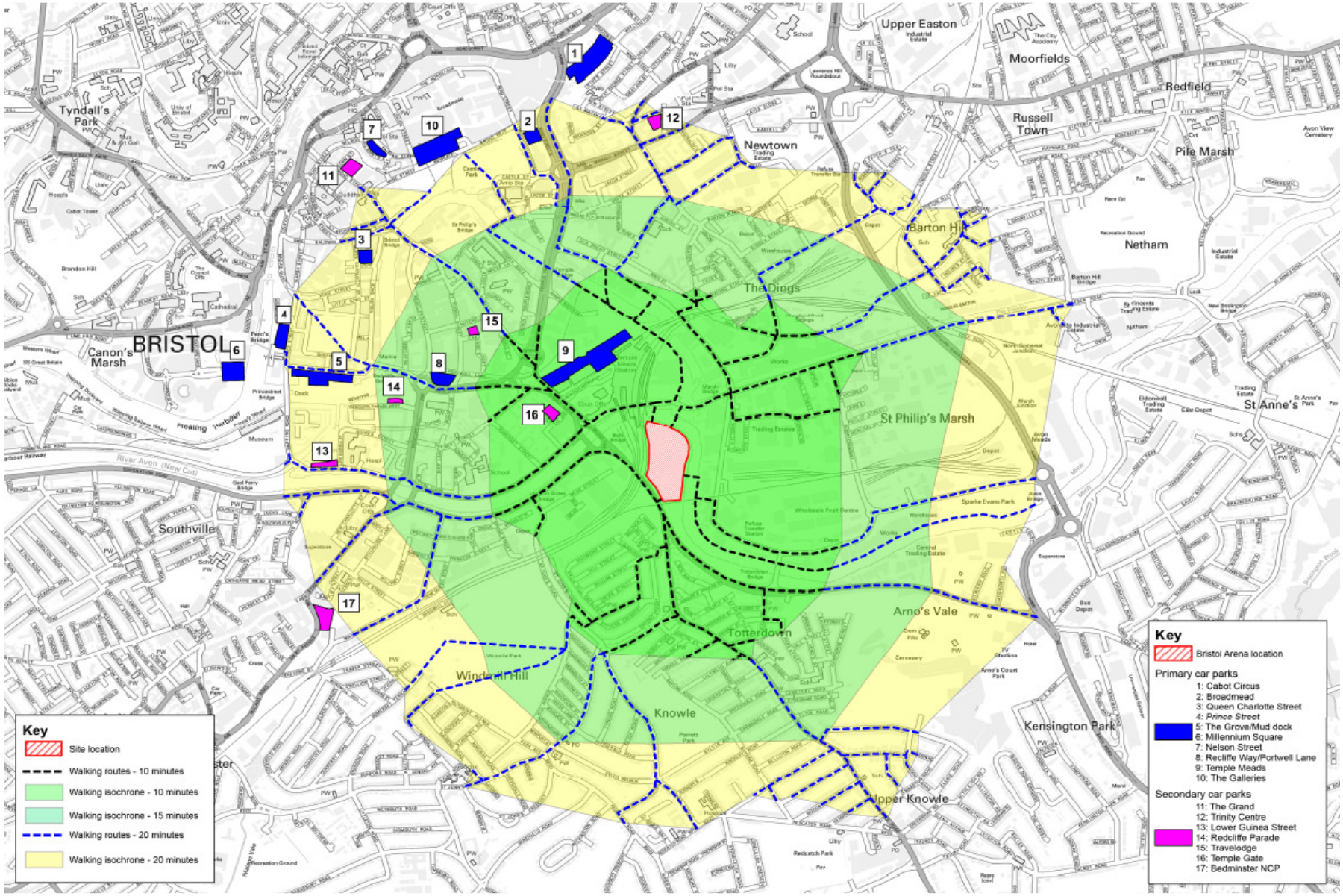
The location of car parks in proximity to the Arena site is shown in **Figure 3.8.**

A total of 10 public car parks have been identified as 'Primary' status and these include:

- **Cabot Circus (2500 spaces).** This is the largest public car park situated in Bristol City Centre, primarily serving the Cabot Circus shopping centre and surrounding retail streets. The car park is barrier controlled, open 24 hours, with primary access provided from the A4044 Bond Street and a further access provided from Houston Street. An exit is also provided from the car park on the A4044 Temple Way southbound carriageway;

- **Broadmead (468 spaces).** This car park is a 24 hour public car park, barrier controlled, with primary access provided from Lower Castle Street. An exit to the car park is provided on both Lower Castle Street and the A4044 Temple Way northbound carriageway;
- **Queen Charlotte Street (282 spaces).** This is a barrier controlled multi-storey NCP car park, open 24 hours a day;
- **Prince Street (311 spaces).** This is a barrier controlled multi-storey NCP car park, open 24 hours a day;
- **The Grove / Mud Dock (113 spaces).** This is a street level car park access from The Grove. This car park is pay & display;
- **Millennium Square (524 spaces).** Positioned to the south of Harbour Square and Millennium Square, this car park is operational 24 hours, 7 days a week. Access to the underground car park is provided via the A4 Anchor Road and Cannons Way;
- **Nelson Street (269 spaces).** Nelson Street is a large multi-storey NCP car park located just of Nelson Street on All Saints Street. This car park is open 24 hours, 7 days a week;
- **Redcliffe Way/Portwall lane (170 spaces).** A street level car park bounded by Portwall Lane to the north and the A4044 Redcliffe Way to the south. Access is provided by Phippen Street;
- **Temple Meads Station (366 public long-stay spaces).** Car parking available at and around Temple Meads Railway Station is provided outside of the station. At present, 366 spaces are provided, although this number has the potential to increase in the future following the station's redevelopment;
- **The Galleries (959 spaces - Saturday daytime use only).** The Galleries car park is associated with the Galleries shopping centre located in the City Centre. This car park is available to use on a Saturday morning and daytime, but closes at 2300 each evening. The use of this car park has therefore only been assumed to be used for daytime events, and has been excluded from evening calculations in the analyses discussed later in the TA.

Figure 3.8: Public off-street car parks considered viable for Arena visitors and walk isochrones



In addition to the primary car parks identified above, it is also possible to park in a number of smaller and more local car parks in the city centre. These include:

- **The Grand Hotel (150 spaces).** This is a 24 hour public car park associated with The Grand hotel, although non-residents are also welcome to use the car park. Access is provided from Broad Street;
- **Trinity Centre (75 spaces).** A 24 hour pay & display car park accessed from the A420 close to the Lawrence Hill Roundabout;
- **Lower Guinea Street (22 spaces).** A small pay & display car park taking access off Redcliff Hill, north of the Bedminster Bridge Roundabout;
- **Redcliffe Parade (35 spaces).** A small car park situated on the north side of the Redcliff Parade carriageway. This is a pay & display car park;
- **Travelodge (50 spaces).** APCOA operated car park associated with the Travelodge hotel situated on Mitchell Lane. Parking is available for non-residents;
- **Temple Gate (45 spaces).** A multi-storey car park accessed from Chatterton Street, in close proximity to A4 Temple Gate junction. This car park is barrier controlled and operates on a 24 hour basis. There is a total of 425 spaces, but most of these are private for use with an adjoining hotel and designated for BCC contractors; and
- **Bedminster NCP (170 spaces).** A street level car park operated by NCP. Opening 24 hours.

In total there are 5,003 primary car parking spaces (or 5962 with the Galleries) and 697 secondary car parking spaces available within the City Centre which could be used by Arena visitors subject to availability at different times.

3.3.1.2 Discounted Locations

Table 3.8 below identifies those car parks which have been discounted as suitable visitor parking locations, either because they are designated for public customers, are not open at times suitable for an Arena event, or offer only 'short stay' parking which would not extend to cover the length of an Arena event taking place.

Table 3.8: Car parks discounted from consideration

Car park locations	Total no of spaces	When open - weekday	When open - Saturday	Long/short stay	Public/private
Lidl	77	08:00-21:00	08:00-21:00	Long stay	Public / Customers only
Avon Meads Retail Park	750	24 hours	24 hours	Long stay	Customers only
Duncle Road	50	24 hours	24 hours	Short stay, max 3 hours	Public
Gardiner Haskins	300	06:30-20:00	08:30-18:00	Long stay	Public
Queen's Square	159	24 hours	24 hours	Short stay, max 2 hours	Public
Wapping Warf	600	24 hours	24 hours	Long stay	Now being built on-housing
Bristol 1st Hotel	40	08:00-18:00	08:00-18:00	Short stay, max 4 hours	Public
ASDA Bedminster superstore	700	24 hours	00:00-22:00	Long stay	ASDA Customers
Little Paradise	56	24 hours	24 hours	Short stay, max 3 hours	Public
Hereford Street	52	24 hours	24 hours	Short stay, max 3 hours	Public
Sainsbury's St. Philip's Causeway	350	07:00-22:00	07:00-22:00	Long stay	Public, Customers only
Broadwalk	500	05:30-23:00	05:30-24:00	Long stay	Public

3.3.1.3 Off-Street Parking Availability

Surveys were undertaken at the selected off-street car parks in March and May 2015 to identify the availability of parking spaces for Arena event attendees during expected arrival periods. Surveys were conducted at half hour internals during the time periods when event attendees would begin to arrive and look for spaces. These were completed for a weekday evening and for Saturday daytime and evening periods.

Weekday surveys were undertaken at half hourly intervals starting at 1630, which is 3 hours prior to the expected start of a weekday evening event. At 1630 a high proportion of City Centre car parking spaces remain occupied by employees or shoppers, but with spaces becoming available as the commuter peak period commences. The period of overlap when event attendees arrive, and prior to commuters departing, is the critical time in terms of car parking supply.

On a Saturday existing car park usage surveys were undertaken between 1300 and 1530hrs, and 1630 to 1930 in an evening. The Saturday daytime period was chosen to cover an overlap in morning family matinee spectators departing this event and midday matinee visitors arriving.

Both the weekday and Saturday parking occupancy results for the selected periods are included in **Appendix D**. These showed that for the typical time of year surveyed that:

- Weekday Evening: An existing overall 70-80% car park utility at 5:00pm falls to circa 30% by 7:00pm. Of the 6,506 spaces potentially available to visitors, an occupancy level of 4,525 at 1700 had fallen to 2,076 by 1830;
- Saturday Evening: An existing overall 60% car park utility at 5:00pm falls to circa 40% by 7:00pm. By 1830 circa 2,800 (43%) of the overall 6,506 space supply remained in use; and
- Saturday Daytime: An overall car park utility of circa 72% was maintained between 1:00pm and 3:00pm, with around 4,700 of the available 6,506 space supply considered constantly in use.

3.3.2 On-Street Parking

3.3.2.1 General

In addition to the identified off-street parking available within a reasonable walk distance of Arena Island, there is also a considerable quantum of on-street parking in the same zone. This is both an asset and an area of concern for the Arena proposals, particularly where this may impact of residential streets.

3.3.2.2 Existing Resident Controlled Parking Zones

Bristol has a series of Resident Parking Schemes (RPS) in place in an around the city that restrict car parking to residents at certain times. These schemes also include a limited amount of pay and display parking availability, but with a time limit of up to three hours. Sixteen RPS areas are currently in operation in Bristol. Permits, which are available to residents and their visitors, are required to park in these locations. It is free to park in RPS areas on Bank holidays and Sundays, except in the Bower Ashton RPS.

Schemes operate from Monday to Friday between 0900 and 1700, including the two in the process of implementation. As such, whilst these residential areas with RPS schemes in place will have protected on-street parking during the day, the Arena proposals will inevitably introduce car parking demands from visitors outside these times. As discussed later in the Mitigation chapter of this TA, consideration has been given to extending the times at which some of the existing RPS's operate, depending on their proximity to the Arena venue.

The existing and 'being implemented' RPS areas are shown in **Figure 3.9**.

3.3.2.3 Windmill Hill / Totterdown

The residential areas of Windmill Hill and Totterdown are not currently subject to a RPS. However, given their proximity to Arena Island and the quantum of unrestricted parking available, there is potentially a high risk of visitors seeking on-street parking spaces in these areas. This risk is recognised and measures considered necessary to control undesirable visitor parking considered later in the TA under 'Mitigation'.

3.3.2.4 St Philips Marsh

St Philips Marsh is the industrial area east of the Arena Island, which is bounded by railway lines to the north and the River Avon to the south. This area has a supply of over 600 on-street spaces. Whilst this parking is largely unrestricted, it is well used by businesses until 1800hrs, at which point a significant volume of on-street parking spaces become available for use in the evenings. At the weekend, few businesses are in operation and on-street parking supply is plentiful.

On-street car parking surveys were conducted during a weekday and Saturday evenings in July 2015 to determine the overall provision and availability of parking spaces during these periods. Surveys were conducted on roads situated within the St Philips Marsh area on Wednesday 15th July 2015 and Saturday 18th July 2015 between the hours of 1600 and 1900. The maximum number of spaces available for parking on-street was identified from the site surveys, but with on-street parking provision reduced to take account of planned highway network changes and proposed parking restrictions in this area. These changes will see the cycle route extended and footways widened in several locations, and as a result, on-street parking provision will be affected.

On-street parking use and available spaces for the St Philips Marsh area is presented below in **Table 3.9** for a weekday, and in **Table 3.10** for a Saturday. It should be noted that the Bristol Harbour Festival was also occurring on the Saturday in which the survey was undertaken, so the figures in this case represent a worst-case Saturday demand scenario for on-street car parking demand in the City Centre.

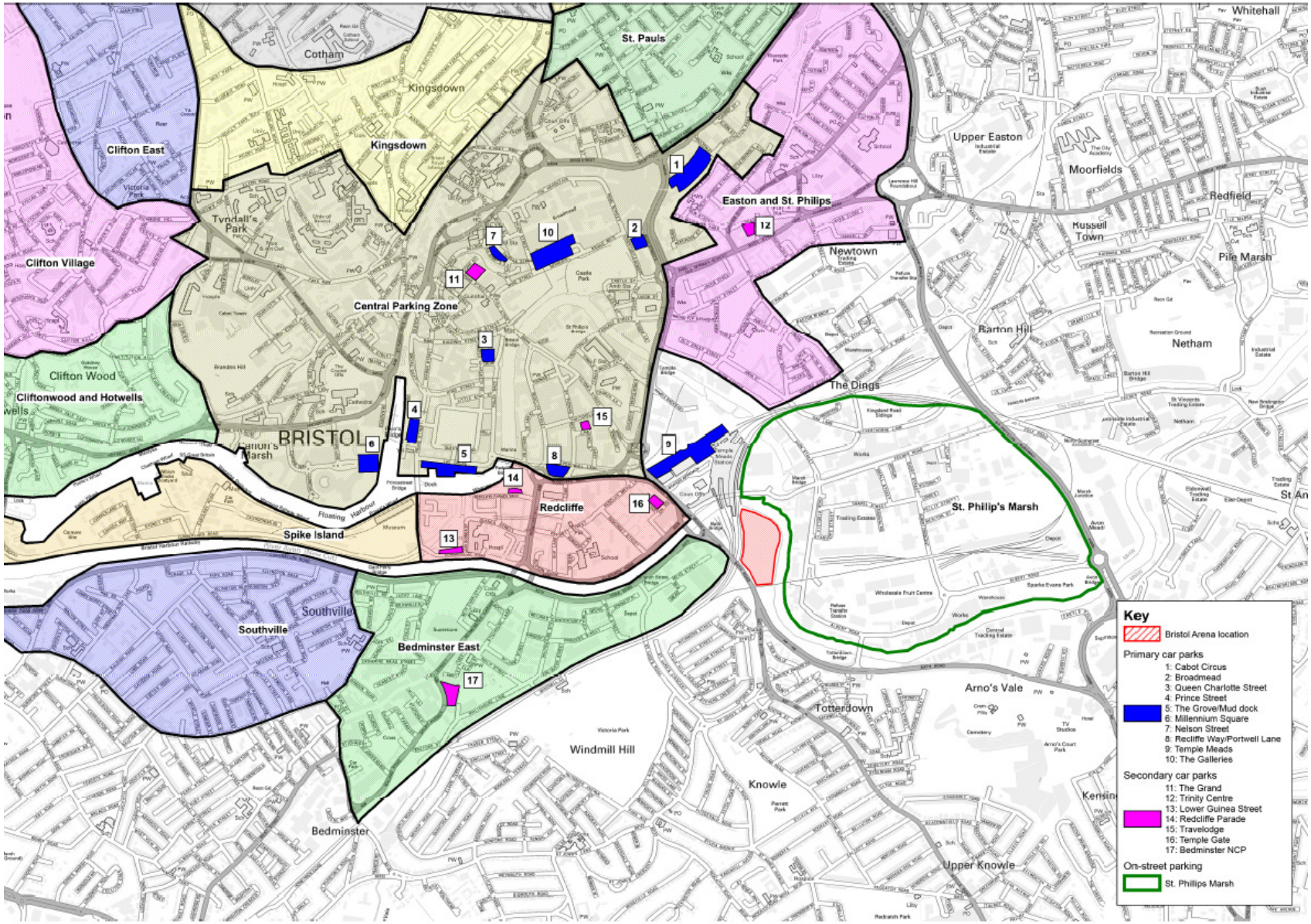
Table 3.9: Weekday evening on-street parking supply (St Philips Marsh)

Road Name	Est. total spaces	1600-1700		1700-1800		1800-1900	
		taken	available	taken	available	taken	available
Albert Road	51	7	44	6	45	4	47
Victor Street	5	1	4	2	3	1	4
Victoria Road	5	5	0	5	0	3	2
Stanhope Street	36	20	16	4	32	1	35
Lansdown Street	14	7	7	6	8	3	11
Meriton	26	15	11	8	18	2	24
Albert Crescent	17	5	12	5	12	3	14
Short Street	30	19	11	7	23	5	25
Philip Street	14	8	6	6	8	1	13
Victoria Terrace	22	18	4	3	19	2	20
Chapel Street	92	68	24	42	50	22	70
Camnal	10	10	0	8	2	3	7
Small Street	38	24	14	11	27	4	34
Arthur Street	19	12	7	12	7	7	12
Atlas Street	27	12	15	6	21	2	25
Cole Road	48	25	23	17	31	5	43
Feeder Road	6	46	-40	26	-20	11	-5
Silverthorne Lane	93	22	71	11	82	4	89
Kingsland Road	34	14	20	14	20	11	23
Gas Lane	43	16	27	16	27	9	34
Freestone Road	12	9	3	9	3	10	2
Total	642	363	279	224	418	113	529

Table 3.10: Saturday evening on-street parking supply (St Philips Marsh)

Road Name	Est. total spaces	1600-1700 taken	1600-1700 available	1700-1800 taken	1700-1800 available	1800-1900 taken	1800-1900 available
Albert Road	51	3	48	3	48	2	49
Victor Street	5	0	5	0	5	0	5
Victoria Road	5	0	5	0	5	0	5
Stanhope Street	36	3	33	2	34	2	34
Lansdown Street	14	0	14	0	14	0	14
Meriton	26	0	26	0	26	0	26
Albert Crescent	17	1	16	1	16	1	16
Short Street	30	0	30	1	29	0	30
Philip Street	14	0	14	0	14	0	14
Victoria Terrace	22	1	21	1	21	0	22
Chapel Street	92	15	77	15	77	13	79
Camnal	10	0	10	0	10	0	10
Small Street	38	6	32	6	32	5	33
Arthur Street	19	5	14	3	16	1	18
Atlas Street	27	0	27	0	27	0	27
Cole Road	48	3	45	3	45	2	46
Feeder Road	6	17	-11	16	-10	16	-10
Silverthorne Lane	93	9	84	10	83	11	82
Kingsland Road	34	12	22	12	22	12	22
Gas Lane	43	16	27	16	27	9	34
Freestone Road	12	5	7	5	7	4	8
Total	642	96	546	94	548	78	564

Figure 3.9: Existing and to be implemented Residents parking Scheme (RPS) areas in Bristol and location relative to the Arena Island



3.4 Highway Safety

Road safety is a key consideration of site accessibility, as patterns in Personal Injury Accidents (PIA) can reveal issues and/or conflicts between the various modes of travel. For a development such as an Arena, attracting a wider variety of transport modes, this is a key consideration. PIA results also identify issues with wider area junctions and links that may be affected by the traffic increases associated with the development proposals.

PIA data has been obtained from BCC for the five year period between 1st December 2008 and 31st November 2013. An expansive area has been considered as part of the safety review, including all the local junctions and links most likely to be affected by pedestrian, cyclist and vehicle trips associated with the proposals. The area covered is shown in **Figure 3.10**.

Junctions include:

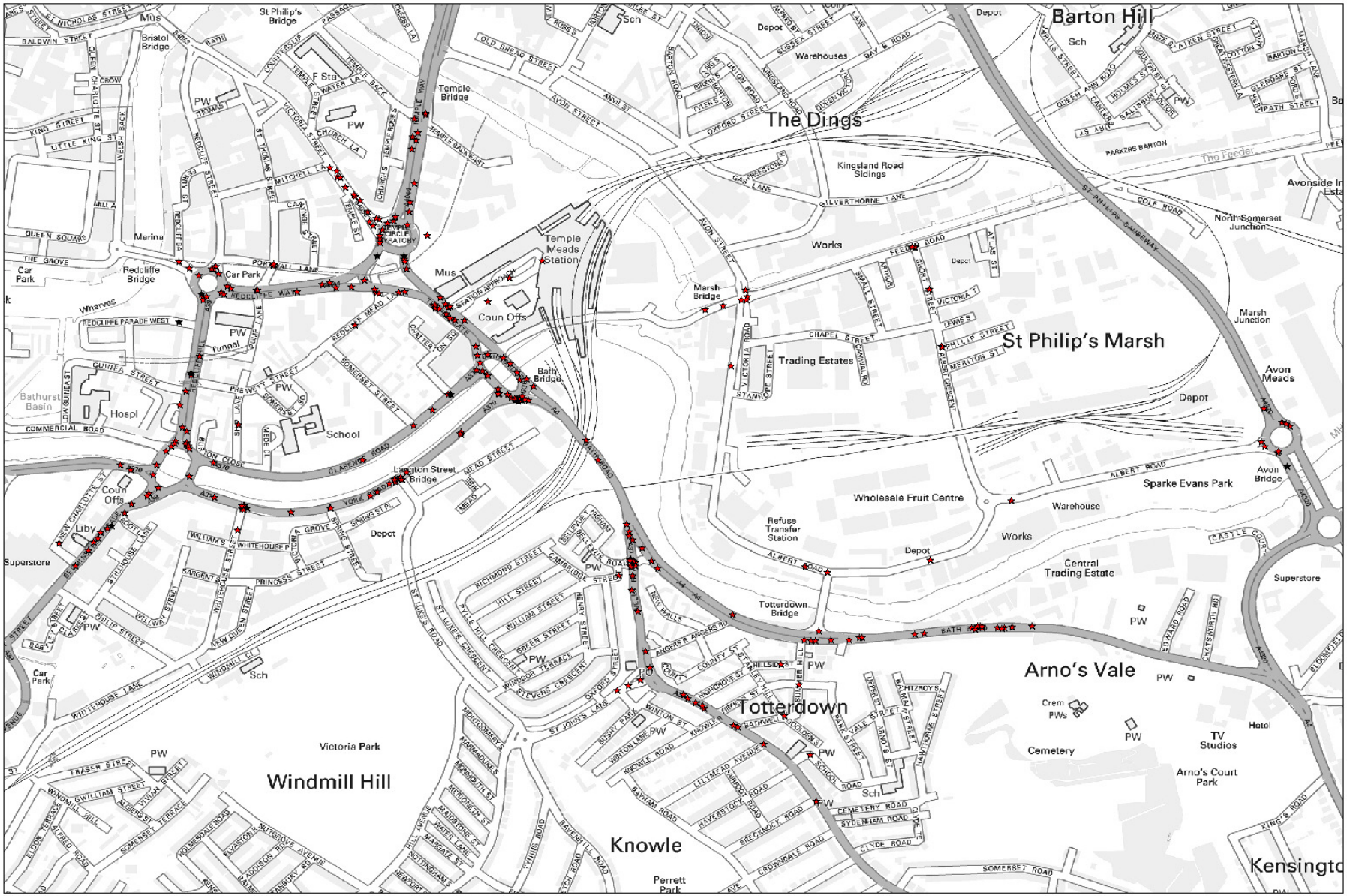
- Bath Bridge Roundabout;
- Bath Road/Wells Road junction - 'Three Lamps';
- Bedminster Bridge Roundabout;
- Redcliffe Way/Redcliff Hill roundabout;
- St. Philips Causeway/Albert Road roundabout;
- Temple Circus Roundabout; and
- York Road/Whitehouse Road junction.

In addition to the above junctions a number of vehicle corridors have also been included and covered in the safety analyses:

- Albert Road and Albert Crescent;
- Bath Road;
- Bedminster Parade;
- Clarence Road;
- Feeder Road;
- Portwell Lane;
- Redcliff Hill;
- Redcliffe Way;
- Temple Gate;
- Temple Way;
- Victoria Street;
- Wells Road; and
- York Road

A final category titled 'other areas' includes those other locations in which a smaller number of accidents have occurred, but aren't included under one of the junction or corridor headings previously mentioned. A total of 281 PIAs have been recorded in this five year period. A summary of these by location, year and injury severity is presented in **Appendix E**, together with all the source data used.

Figure 3.10: Personal Injury Accident (PIA) locations within the Study Area



With respect to the identified junctions, the largest cluster of PIAs has occurred at Bath Bridge Roundabout, with 35 accidents comprising 33 involving slight injury and two with serious injuries. The greatest number of PIAs at this roundabout occurred during 2009, with a total of 13 accidents including 12 with slight injury and one with serious injury. This matches the overall trend of accident occurrences in the analysis area, in which 2009/2010 saw the highest number of accidents across the study area as a whole, with 68 PIAs consisting of 62 slight, 5 serious and 1 fatal accidents.

In terms of PIAs on the 'link' sections considered, Bath Road has shown the highest frequency of accidents, with a total of 25 accidents over this five year period. The severity split in this case is 23 slight injury accidents and two serious accidents.

There has been a significant decline in PIAs in the analysis area over the past five years, with approximately a 40% decline in PIAs since the peak in 2009/2010.

A vulnerable user assessment was also carried out to determine the number of PIAs that involved children under 18, pedestrians or cyclists over the 5 year period. Similar to before, Bath Bridge Roundabout had the highest number of vulnerable users involved in PIAs at 19, equating to approximately 54% of the PIAs that took place here. However, this is only slightly above the average for the analysis area, as approximately 48% of all PIAs involved a vulnerable user (135 of 281).

Baseline Highway Operation and Modelling

4.1 Introduction

This chapter sets out the parameters used to model the operation of the existing highway network and its key junctions in the city centre. It sets out agreements with Bristol City Council's Transport Development Management (TDM) officers regarding assessment criteria, and presents the baseline modelling results. These are provided to show that the traffic models reflect existing highway operating conditions in the time periods of interest, and so validated and suitable for determining Arena traffic impacts associated with forecast modelling scenarios.

4.2 S-Paramics Model Development

4.2.1 Model Network Extents and Specification

For the purposes of modelling the detailed impacts of Arena traffic on the City Centre highway network, a S-Paramics micro-simulation model was developed. The extents of the agreed network is shown in Figure 4.1 below.

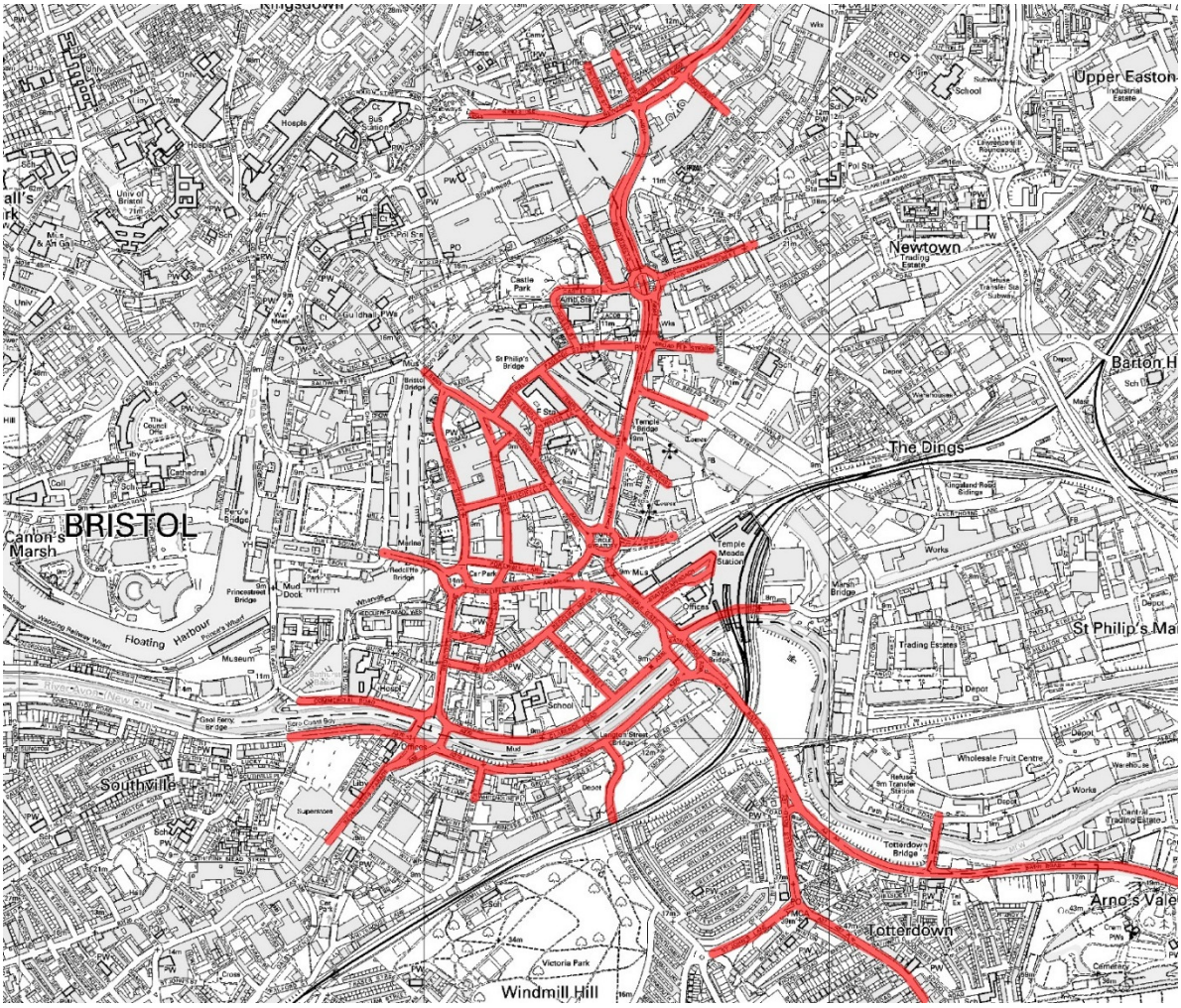


Figure 4.1 S-Paramics Model Extents (BCC OS License No. 100023406)

The Bristol Arena S-Paramics model network extends from Newfoundland Circus gyratory in the north to Totterdown Bridge and St John's Lane in the south, with all critical junctions along the A4044 Temple Way/A4 Bath Road route included. The model also extends west of the main Temple Way route to include Victoria Street, the Redcliffe area, Redcliffe Way, Redcliff Hill, Clarence Road and York Road, with the Redcliffe and Bedminster Bridge roundabouts also included in the network.

Traffic signal timings throughout the model network were based on AVSP SCOOT timings supplied by Bristol City Council for the weekday evening peak period Saturday modelled periods. The AVSP information enabled stage lengths and relative offsets during modelled periods to be estimated and used as a starting point for signal timings within the modelled network with some minor changes made to these timings as part of the calibration of the models.

Bus services passing through the cordon model network were expanded to the new network extents and updated in terms of service timings. The routes were coded into the model as fixed route vehicles with start times and frequencies as per the relevant timetable information. A standard bus dwell time of 30 seconds was employed at bus stops throughout the network, with a higher 100 seconds dwell time assumed for stops within the sphere of influence of Temple Meads station, namely bus stops Ta, Tb, Te, Tef, Tg and Tj.

4.2.2 Model Time Periods

As agreed with Bristol City Council during the scoping of the Arena modelling work, three models have been developed covering the weekday evening period (3:00 to 8:00pm), Saturday afternoon period (12:00 to 3:00pm) and the Saturday evening period (4:00 to 7:00pm). The model periods include an hour long warm-up period prior to the core assessment hours. This is needed to allow the network to become populated with vehicles and become suitably busy before output statistics are collected. The modelling of time periods longer than one hour enables vehicles held-up in congestion during the busiest hour to complete their journeys and thus the delays incurred by these vehicles to be captured in the model outputs.

4.2.3 Development of Trip Matrices

To develop matrices for the model, origin-destination patterns were observed using the Bristol City Council Automatic Number Plate Recognition (ANPR) system. Origin-destination data was extracted from the system on the 30th April 2014 for the weekday evening peak period, for the development of the Temple Circus model, and on the 25th April 2015 for the Saturday models. The data was subjected to a 'cleansing' process in order to remove duplicate number plate matches and illogical travel patterns.

Weekday turning count data for the model area was available as part of the Greater Bristol Area Transport Study (GBATS) model update. These counts were carried out during the 26th and 27th June 2013 between 7:00am, and 7:00pm at the following locations:

1. Cabot Circus gyratory;
2. Old Market roundabout;
3. Narrow Plain/Temple Way;
4. Temple Way/Temple Back;
5. Temple Circus roundabout;
6. Temple Gate/Redcliffe Way;
7. Bath Bridge roundabout;
8. Bedminster Bridge roundabout;
9. Redcliffe Way roundabout, and
10. Victoria Street/Counterslip.

Automatic traffic counter (ATC) traffic data from the GBATS model update collected during June 2013 was also available at numerous locations providing 24 hour traffic data which also provided link flow volumes for Saturdays. ATCs were available at the following locations (with data available in both directions unless otherwise specified):

1. M32 Newfoundland Way;
2. Old Market Street;
3. Avon Street;
4. Cattle Market Road;
5. Bath Road (north of Three Lamps);
6. St Lukes Road;
7. Bedminster Parade;
8. Coronation Road;
9. Whitehouse Street, and
10. Station Approach.

To provide the additional turning count data needed for the weekday and Saturday models further surveys were carried out by Axiom Traffic Limited on Tuesday 4th March 2014 and Saturday 8th March 2014 between 12:00 and 3:00pm, and by Nationwide Data Collection on Saturday 25th April 2015 between 4:00 and 7:00pm (with the Cabot Circus gyratory survey carried out between 12:00 and 7:00pm). These surveys were conducted at the following locations:

1. Cabot Circus gyratory (Saturday 25th April 2015 only);
2. Temple Circus roundabout;
3. Bath Bridge roundabout;
4. Bedminster Bridge roundabout;
5. Redcliffe Way roundabout;
6. Three Lamps;
7. Bath Road/Totterdown Bridge, and
8. Wells Road/St John's Lane.

4.2.4 Model Calibration and Validation

Full details of the level of calibration and validation achieved for the three base-line models is provided in the Local Model Validation Report (LMVR) included in **Appendix F**. The detailed results are not replicated within this body text to the Transport Assessment. However, in summary the outcome model calibration results demonstrate that the models meet DMRB acceptability criteria within each period for turning count calibration across a number of critical locations where checks have been carried out. For a network of this size and complexity, with so much available route choice within the model, achieving this level of turning count calibration is very good and far exceeds the requirements of DMRB which only states a need for link count calibration.

The models have been validated to hourly ATC link flows and journey times from the BCC ANPR system. As can be seen in the results in the LMVR, the models are simulating correct traffic volumes throughout the model periods, and are replicating traffic conditions within the network. The journey time validation results meet DMRB criteria with 89 per cent of routes in both weekday evening (5:00 to 6:00pm), Saturday afternoon (1:00 to 2:00pm) and Saturday evening (5:00 to 6:00pm) hours meeting the required acceptability criteria.

SECTION 5

Committed Transport Improvements

5.1 Introduction

Notwithstanding any specific improvements associated with the Arena proposals, a series of large scale infrastructure schemes are committed and will provide improved accessibility to Arena Island. These schemes will benefit both Arena spectators and Arena staff, and would be in place and operational prior to the Arena site opening.

5.2 Temple Gate Scheme

The scheme includes the reconfiguring of the existing Temple Circus gyratory and Temple Gate corridor, creating a new city gateway and enhanced environment for pedestrians and cyclist use. The Temple Gate scheme will have a simplified road layout and provide a more direct route for vehicular traffic. The scheme is to include:

- Extension to the 'Brunel Mile', providing a direct pedestrian link between Temple Meads and Millennium Square;
- Providing a single wide crossing point for pedestrians and cyclists to accommodate high volumes travelling between the Arena and the city centre;
- Improvements to cycle routes with better connections to new cycle paths on Clarence Road and Cattle Market Road and beyond to the wider Bristol cycle network;
- De-cluttered footways;
- Upgraded and increased number of bus shelters;
- Improved signage and way finding;
- A new MetroBus stop, close to Bristol Temple Meads Railway Station and Arena Island; and
- The delivery of space for new buildings and a public square.

5.3 Temple Greenways Projects

The Temple Greenways projects tie in directly with access to the Arena Island, concentrating along Cattle Market Road which is the primary route connecting the site to the City Centre and Temple Meads Railway Station. These projects include:

- Improved walking and cycling routes between the Arena and the city centre, focussing on the southern edge of Bristol Temple Meads Railway Station (on Cattle Market Road) and the north eastern edge (a new Harbour Walkway);
- Released carriageway space (Cattle Market Road will become a single carriageway eastbound route for vehicles) to provide a wide and attractive route for pedestrians and cyclists to access the Arena site, including a segregated two-way cycle path;
- Provision of a new Harbour Walkway for pedestrian and cycle access to the Arena along the north-eastern edge of Bristol Temple Meads Railway Station, where access is not currently possible. The walkway extends southwards from the ferry landing stage at Temple Quay towards the Arena, via Totterdown Basin, where the Floating Harbour meets the Feeder Canal. The walkway is expected to encourage waterside development of currently disused sites. All structures have been designed to

accommodate the volumes of people attracted by major events and both sides will have safety hand rails. The walkway will be accessible by all, including people with vision impairments or physical disabilities; with suitable ramps and a flat, non-slip surface.

Figure 5.1 below shows what the Harbour Walkway will look like, this providing a new pedestrian/cycle linkage between Temple Quay and Totterdown Basin.

5.4 MetroWest

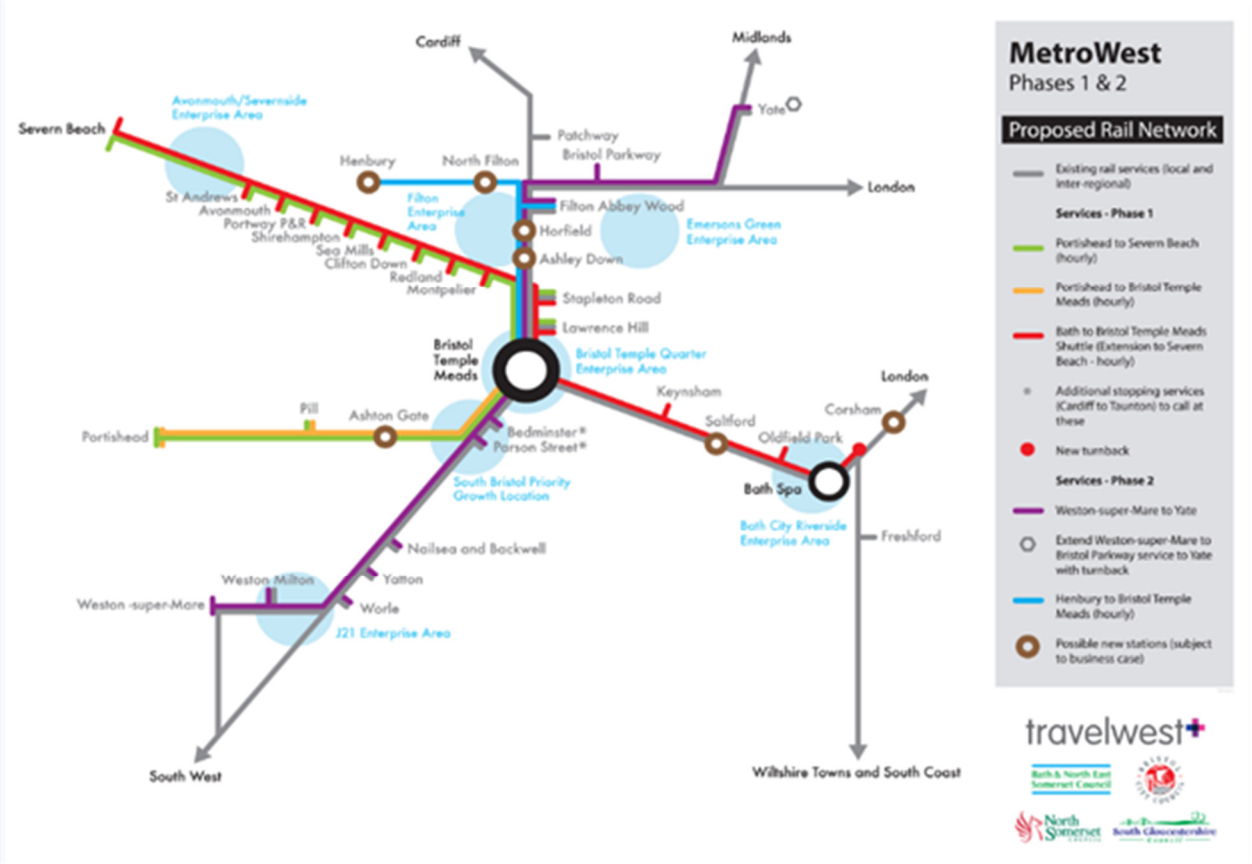
MetroWest is a ten year project to provide train services with a minimum half-hourly frequency on all routes within the main Bristol commuting area (see Figure 5.2). It will link up major growth areas in the EZ and the five Enterprise Areas in the West of England.

Phase 1 is to include the reopening of the Portishead line, half hourly train services for the Severn Beach line, more trains serving Keynsham, Oldfield Park, Bedminster and Parson Street. Services will begin operating in 2019.

MetroWest Phase 2, to open in 2021, includes half hourly train services to Yate (with a potential extension to Gloucester) and hourly services on a reopened Henbury line with new stations at Ashley Down, North Filton and Henbury.

The MetroWest programme also includes a 'new stations package' to consider potential new stations at Saltford, Ashton Gate and Corsham, subject to separate business cases and funding.

Figure 5.2: MetroWest Scheme



5.5 MetroBus

MetroBus is part of the TravelWest investment by the four Council's in local public transport. MetroBus is a £200 million project investment in a high quality, express, reliable, and frequent public transport system known as Bus Rapid Transit (BRT). It is part of an integrated approach to improving public transport in the area. MetroBus will be given priority over other traffic at junctions, which also allows for better cycling and pedestrian facilities. MetroBus will connect the south Bristol area with the large attractors i.e. employers,colleges and schools, in the north, and will link with the rail network at Parson St/Bedminster, Temple Meads and Parkway, supplementing the existing bus network.

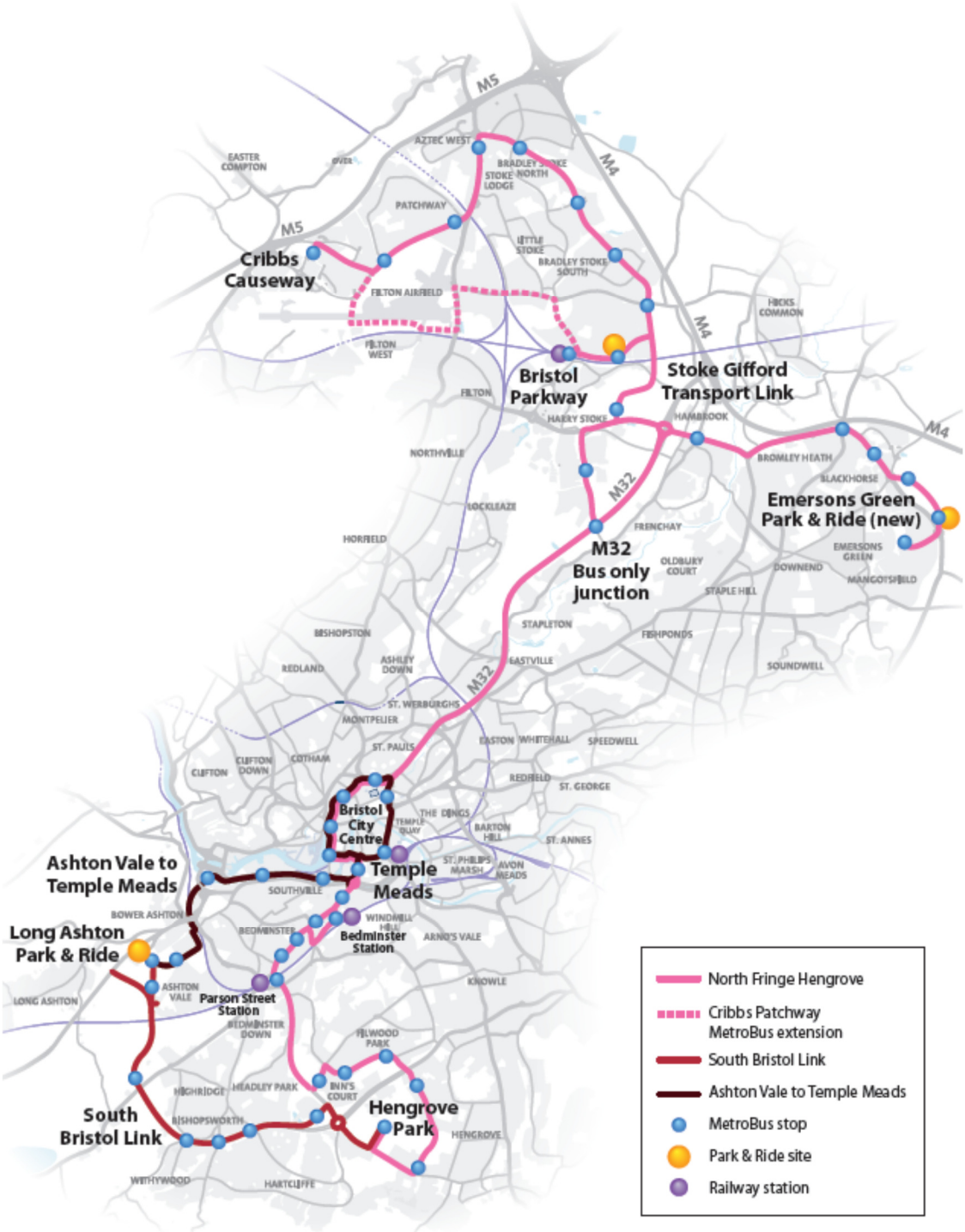
The MetroBus network comprises three interlinked bus routes (see **Figure 5.3**):

- Ashton Vale to Temple Meads - This MetroBus (Rapid Transit) route will provide frequent services from Long Ashton Park and Ride to Bristol Temple Meads and around Bristol city centre. Four kilometres of the route, from Long Ashton Park and Ride to the Arnolfini, will be made up of largely segregated guided busway. The route serves the city centre in the form of an anti-clockwise loop running on existing highway via Temple Circus, Cabot Circus, Broadmead and the centre;
- The North Fringe to Hengrove - This MetroBus (Rapid Transit) route will connect key employment hubs (Cribbs Causeway, Aztec West, Science Park at Emersons Green and Bristol city centre) with key residential areas in the north and south of the city (such as Bradley Stoke, Stoke Gifford, Emersons Green, Bedminster, Knowle West and Hengrove;

- The South Bristol Link - This is a combined road and MetroBus (Rapid Transit) route between the A370 Long Ashton bypass and Hengrove Park. The route will include new paths for walking and cycling. The South Bristol Link connects with the wider MetroBus network comprising the North Fringe to Hengrove and the Ashton Vale to Temple Meads routes.

The completion of the routes will significantly upgrade the public transport services operating through the Temple Meads area, in close proximity to Arena Island.

Figure 5.3: MetroBus Scheme



5.6 Other Pedestrian and Cycle Route Enhancements

Other pedestrian and cycle enhancements not referred to above include:

- Way finding improvements in the City Centre. These comprise on-street information panels with city and area maps and visitor information to indicate routes to/from the Arena to major interchanges, such as Bristol Temple Meads Railway Station, key car park locations and taxi hubs;
- The West of England Local Enterprise Partnership (LEP) has been successful in obtaining Cycle City Ambition Fund (CAF) grant funding to deliver ambitious improvements to the cycling network in the West of England. Infrastructure schemes currently being developed through the CAF programme will provide benefits in and around Arena Island such as improved links to the city centre and improvements along key corridors, including an improved route between south Bristol and the central area. The Cycle City Ambition Fund aims to increase cycle use by 78% by 2016 (based on 2008 levels); and
- Widening of the existing footway along the length of Feeder Road to create a shared use path for pedestrians and cyclists. Junction improvements to facilitate the cycle route will also be provided. These improvements will connect with the existing strategic cycle network to improve access to Arena Island and the wider Enterprise Zone from the east of Bristol.

SECTION 6

Highway Modelling: Reference Case

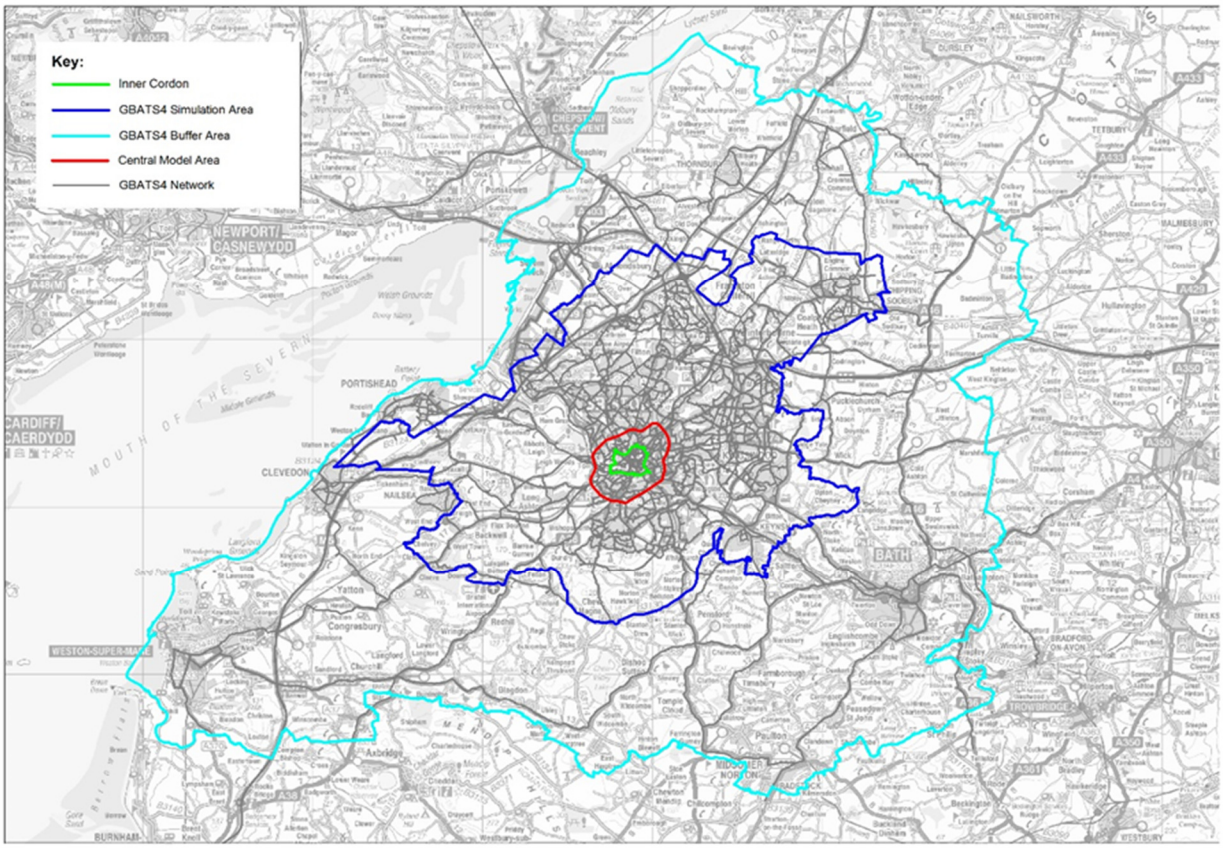
6.1 Introduction

This chapter describes the approach adopted in developing the Reference Case models used for comparison with the various Arena event scenarios. This has involved use of the wider strategic 'Greater Bristol Area Transport Study' (GBATS) SATURN model of the Bristol area, with this information then used to inform changes made to the more detailed base S-Paramics time period models covering the City Centre as previously described.

6.2 GBATS/S-Paramics Forecasting

The GBATS model consists of a Highway Assignment Model representing vehicle based movements across the Greater Bristol area for a 2013 autumn weekday morning peak hour (08:00-09:00), an average inter-peak hour (10:00-16:00) and an evening peak hour (17:00-18:00). The model 'simulation' network covers the Bristol urban area. Outside this area a 'buffer' network and zone system is used to cover the rest of the UK. **Figure 6.1** shows the wider model area.

Figure 6.1: GBATS Model Network



The GBATS4 model includes two forecast years (2021 and 2036). These include the modelling of all of the committed housing and employment development within the main model area. 2021 was selected as the assessment year, this being the nearest year to the Arena opening year. Between 2013 and 2021 GBATS assumes an additional 30,040 new homes and 38,195 new jobs.

The 2021 Reference Case GBATS model also includes a number of committed highway schemes within the model area, namely:

- The roll out of 20mph limits in Bristol;
- CPNN off-site works package;
- MetroBus;
- Temple Circus intersection, including Cattle Market Road eastbound only,
- M4 and M5 Managed Motorway Scheme around Bristol, and
- Cribbs MetroBus extension.

Cordon matrices for the S-Paramics model area were extracted from the 2013 and 2021 weekday evening peak hour models and matched to correspond to the S-Paramics model zone system. The relative change from 2013 to 20221 was calculated to provide a 'delta' growth matrix of increases to be applied to the base year S-Paramics model matrices. However, initial simulations of the resulting matrix showed that the weekday evening S-Paramics model was unable to cope with the predicted circa 8.7 per cent traffic growth, with each run resulting in a terminal lock-up of the network during the 5:00 to 6:00pm peak hour.

Consequently, the methodology for incorporating GBATS growth into the S-Paramics model was refined in order to take into account the more accurate modelling of congestion within central Bristol in the detailed micro-simulation model. This only applied growth where the S-Paramics matrices were lower than the equivalent GBATS volumes and adjusted growth taking into account congestion on routes feeding the S-Paramics model network. The process was as follows:

- An equivalent 5:00 to 6:00pm hour matrix for S-Paramics was estimated using the 2013 base matrices and where S-Paramics origin (row total) volumes were already higher, the GBATS growth was excluded;
- For growth considered legitimate, the percentage growth for each origin (row total) in the S-Paramics model area implied by GBATS was estimated;
- Growth was then adjusted by factoring by a 'congestion index' for entry links into the S-Paramics network calculated by dividing modelled mean speeds by link speed (typically 30mph), and
- The resulting adjusted growth was then applied to the weekday evening light vehicle matrix origin (row totals). No growth was assumed for heavy vehicles.

Since GBATS does not cover Saturday, the growth implied by the GBATS weekday evening was also applied to the two Saturday time periods in S-Paramics. TEMPRO was examined to understand the expected difference between weekday and Saturday growth. This showed that Saturday growth is predicted to be 92 per cent of weekday growth. A 0.92 factor was therefore applied to the 2013 to 2021 GBATS implied growth before the methodology above was followed using congestion indices derived from the Saturday 12:00-3:00pm and 4:00-7:00pm models.

This methodology increased the S-Paramics light vehicle matrix for the weekday evening period (3:00-8:00pm) from 54,444 vehicles in 2013 to 56,004 vehicles in the 2021 forecast year, equating to growth of 2.86 per cent. The resulting growth in the Saturday (12:00 to 3:00pm) model increased the number of light vehicles from 34,785 vehicles to 35,741 vehicles, equivalent to 2.75 per cent. For the Saturday evening model (4:00-7:00pm), the light vehicle matrix increased from 31,251 vehicles in 2013 to 31,944 vehicles in 2021, equating to growth of 2.22 per cent.

Traffic signal timings retained base model settings. The 2021 Reference Case S-Paramics models also included committed highway scheme within the model network. These changes were chiefly associated with the MetroBus and Temple Circus intersection schemes. These changes include the following:

- Introduction of new bus lanes eastbound on the Commercial Road approach to Bedminster Bridge roundabout and northbound on Redcliff Hill;
- Introduction of a new bus lane northbound on Temple Way from Temple Circus to Old Market roundabout, including widening of the northbound entry to Old Market roundabout from two to three lanes;
- Consolidation of the northbound and southbound Temple Way carriageways to the east of the 'Island' site together with the replacement of Temple Circus roundabout with a signal controlled intersection incorporating a number of banned turns (Temple Way right turns and Victoria Street left-turn);
- Introduction of a wide crossing on the Brunel Mile route across Temple Gate;
- The creation of a new signal controlled intersection between Redcliffe Way and Temple Gate south of the Brunel Mile crossing, and
- Cattle Market Road becoming eastbound only from Bath Bridge, including reallocation of released green time to the Temple Gate and roundabout arms.

6.3 2021 Reference Case Results

The 2021 forecast Reference Case models were run for 20 seed runs in order to collect output statistics. Best practice guidance states that the number of seed runs should reflect the likely variation in model output between each run. As a guide, a sufficient number of seed runs should be carried out until the 95 per cent confidence interval of network delay is less than 10 per cent of the mean. This test was applied to all model runs and confirmed that 20 seed runs was sufficient in all cases to generate statistically robust model output results.

An issue with micro-simulation models, particularly wide-area network models, is the propensity for the network to lock-up under highly congested conditions. This is not grid-lock in the real-world sense of the word but rather an issue associated with the fact that simulated vehicles are not as intelligent as real world motorists who, for instance, leave gaps so that network lock-up does not occur. For all forecast scenarios, lock-up runs, indicated by an accumulation of 2,500 vehicles in the network at the end of the simulation, were excluded from the calculation of results.

Table 6.1 compares the 2013 base year and 2021 Reference Case modelled network performance statistics for the three time periods modelled.

Table 6.1: 2013 Base and 2021 Forecast Year

Network Variable	Weekday 3:00-8:00pm		Saturday 12:00-3:00pm		Saturday 3:00-7:00pm	
	2013	**2021**	**2013**	**2021**	**2013**	**2021**
Mean delay (s)	305	385	313	319	262	263
Total distance (km)	119,306	123,141	70,697	72,531	66,711	67,838
Vehs Entering Network	57,934	59,314	35,172	36,077	31,582	32,279
Vehs at End of Period	602	668	1206	1216	726	732
Journeys Completed	57,332	58,646	33,966	34,862	30,856	31,547

Table 6.1: 2013 Base and 2021 Forecast Year

Network Variable	Weekday 3:00-8:00pm		Saturday 12:00-3:00pm		Saturday 3:00-7:00pm	
Total Network Demand	57,395	58,946	34,992	35,926	31,251	31,999
% Demand Satisfied	99%	98%	96%	96%	98%	97%
Mean Speed (mph)	15	12	14	14	18	18

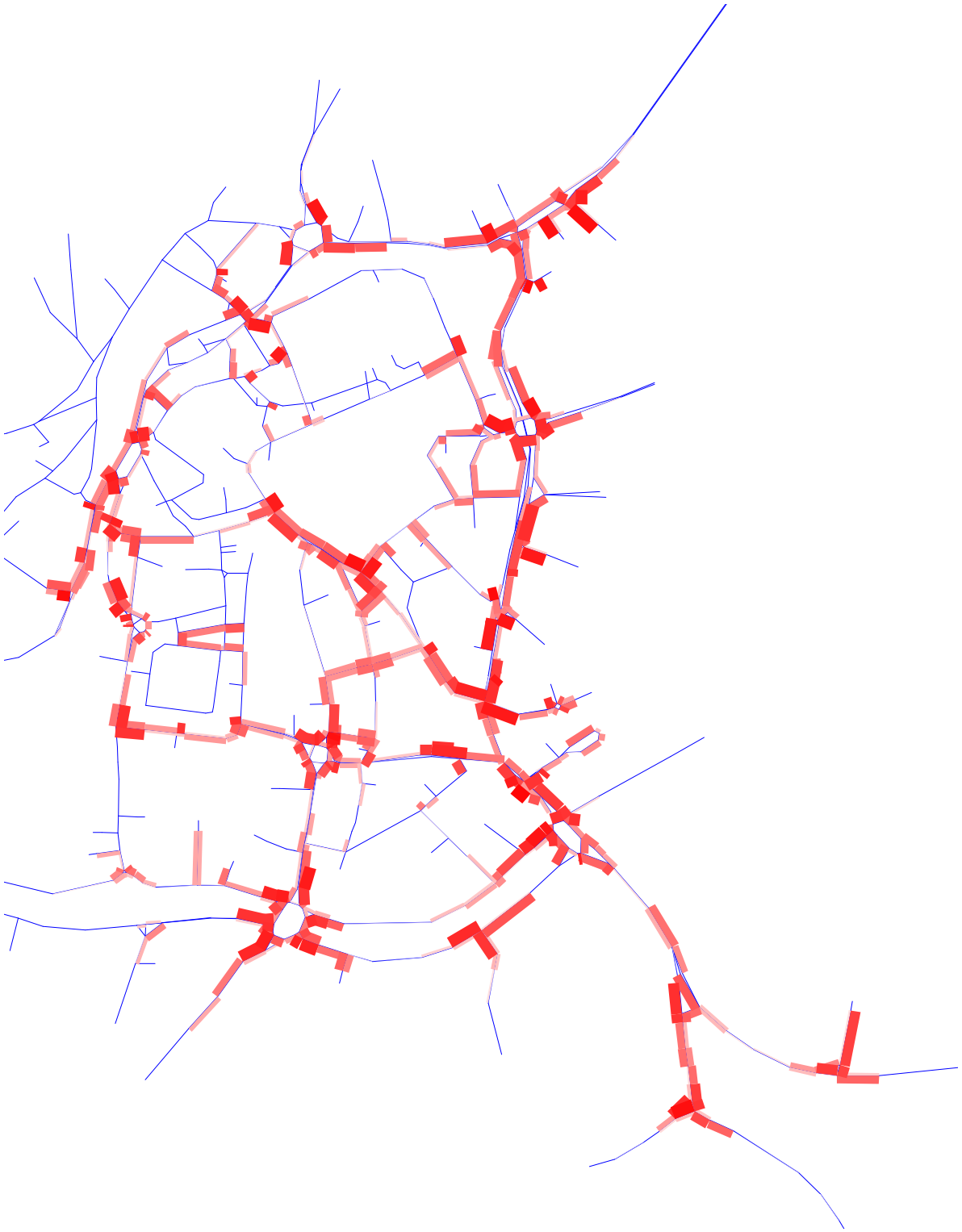
The network performance statistics highlight, as expected, a worsening of conditions by 2021, particularly during the weekday evening peak reflecting the much more congested 5:00 to 6:00pm peak hour within this period. The conditions during this hour in the forecast year have been examined using a normalised congestion plot (see **Figure 6.2**). This is created by dividing the modelled mean speed by the allowable link speed to provide a congestion index between 0 (static) or 1 (free-flowing traffic), which can then be plotted spatially on the model network schematic with thicker and darker bandwidths showing areas of static and slow moving traffic.

Figure 6.2: 2021 Weekday Evening Peak Hour (5:00-6:00pm) Reference Case Normalised Congestion Plot

The plot highlights that in 2021 much of the network during the weekday evening peak hour will be largely static or slow moving. Examination of the plot suggests that areas of notable congestion include Temple Way northbound to the Old Market slip-road signals, Redcliffe Way roundabout and Bedminster Bridge roundabout. Similar plots have been prepared for the 2021 Saturday Reference Case scenario core hours (see **Figures 6.3** and 6.**4**), respectively, although these show much lower levels of congestion throughout the network.

Figure 6.3: 2021 Saturday (1:00-2:00pm) Reference Case Normalised Congestion Plot

Figure 6.4: 2021 Saturday (5:00-6:00pm) Reference Case Normalised Congestion Plot



SECTION 7

Masterplan Proposals

7.1 Introduction

This chapter describes the Arena Island proposals and local transport linkages included in the site Masterplan.

7.2 Development Proposals

The **Phase 1** proposals covered in the detailed planning application includes a 12,000 capacity Arena largely driven by music and entertainment events, with minimal sporting events envisaged. Accompanying the venue, a number of ancillary facilities would include:

- Circulation areas;
- Food and retail concessions;
- Arena Bars;
- Hospitality lounges;
- Executive suites;
- Toilets;
- Office, administration areas, venue control, production and press facilities;
- Box office / ticket collection;
- Dressing rooms;
- Storage areas, plant and service rooms; and
- Service yard and loading area;

These amenities are integral to the operation of the venue and would be for internal venue use only.

The **Phase 2** proposals for the Arena Island covered by the second outline planning application would encompass a mixed land use site complimentary to the Arena venue. The proposals include:

- 8,200sqm commercial office development (B1 land use class);
- 1,400sqm commercial A3 / A1 land use classes; and
- 9,400sqm of residential use (C3 land use class). The residential floor-space as described in the Masterplan would accommodate 64 two bedroom apartments and 16 one bedroom flats (80 units).

The illustrative Phase 1 and Phase 2 proposals for Arena Island are shown on Drawings POP-AR-SP-XX-XX-XXX-0725 and POP-AR-SP-XX-XX-XXX-0726 included in **Appendix G.**

7.3 Site Access

The Arena Island and venue will include the following three points of access for normal vehicular, pedestrian and cyclist access.

7.3.1 Primary Access - HCA Bridge

Primary access to the Arena Island is via a three lane bridge spanning the River Avon, connecting Cattle Market Road to the Arena Island. The bridge has been delivered by the Homes and Communities Agency after securing a government grant of £11m towards its provision. The bridge forms part of the wider Temple Greenway Projects

7.3.2 St Phillips Pedestrian/Cycle Bridge

Positioned to the east of the Arena Island, a pedestrian/cycle bridge will link the Arena site to Albert Road and the River Avon path. The northern part of Albert Road is identified as the main location for coach pick-up / drop-off, so will benefit from a direct connection to the Arena island via this bridge, Although not encouraged, there is also likely to be visitor parking on roads in the St Phillips area, so this bridge will also cater for pedestrian demand from this direction associated with this.

7.3.3 A4 Bath Road Pedestrian/Cycle Link

A new pedestrian linkage between the Arena terrace and the A4/A37 Three Lamps junction is to be made to improve connectivity between Arena Island and the residential areas of Totterdown, Windmill Hill and Knowle to the south. This will require a new pedestrian footbridge over the railway spur running along the south side of the site, and will serve to bypass the narrow footway on the eastern side of the A4 Bath Road where it crosses the two existing railway bridges. Additional works to widen the existing footway between the bridge over the spur line and the Three Lamps junctions will be included. Further details of the assessments done to establish the need for and form of this linkage are discussed later in the chapter covering Arena mitigation.

7.4 Service Access and Servicing Regime

7.4.1 Service Yard and Access

The Arena service yard is located to the back of the building as shown on the drawings and is able to accommodate the simultaneous loading/unloading of 4 HGVs at any one time at an extended loading dock. There is additional parking for up to 4 tour buses in this area which does not impinge on the manoeuvring area needed for HGVs. Access/egress for HGV's would be by way of the HCA bridge, and a service road running along the eastern side of the Arena Island site to the rear of the building, as shown on Drawing No. 034070-BA-BHE-TP-ZZ-DR-00-0001 in Appendix G. Just south of the St Phillips pedestrian bridge and the SE entrance to the Arena this access road will be gated, with only authorised access to the section south of the gate and the yard.

A swept path plot Drawing No. 034070-BA-BHE-TP-ZZ-DR-00-0002 is also included in Appendix G to demonstrate the adequacy of the turning and manoeuvring space provided in the service yard area. In order to load/unload at the extended loading dock, arriving HGV drivers would be required to execute a 180 degree turn as shown on the plot, and then reverse to one of the four spaces available at the docking platform. It is also understood that HGV's will be required on occasion to reverse into the Arena building itself via doors at the back of the building and east of the extended platform. This turning and reversing manoeuvre through 90 degrees will be possible for an HGV, even if all the spaces available at the extended external docking platform are occupied by other service vehicles.

Drawing No. 034070-BA-BHE-TP-ZZ-DR-00-0003 shows the turning and reversing manoeuvres required by waste vehicles to access the compactors west of the loading dock. The confirms that adequate space is available to do this, although a long reversing manoeuvre is required from the main service yard to achieve the required end-on docking position.

7.4.2 Servicing Regime

It is understood from information provided by the operator that, following an event, there is an almost immediate requirement for the dismantling and loading of equipment and stage set to allow HGVs to move onto the next venue as quickly as possible. However, it is accepted that HGVs using the HCA bridge to depart, or arrive, in the 20-30 minute period following the end of an event will not be

acceptable. This is due to the conflict with large numbers of pedestrians using this bridge and its environs to leave Arena Island at this time, and the inherent highway safety issues.

To overcome this issue the proposed servicing regime would seek to ensure that, prior to an event finishing:

- 4nr HGV's, or lesser if not needed, are in place at the extended loading dock to begin immediate loading when required; and
- A further 5-6 HGV's, again as required, are parked on the service road between the yard and the access gate, which would be closed and managed for the required 20-30 minute period after the event to prevent any HGV's leaving the site.

The width of the service road is this 'holding area' is wide enough to accommodate the passage of two HGV's. This will allow any of the four HGV's initially at the loading dock to move clear and wait in the service road to exit once the gate is opened. Once a bay is vacated, one of the other HGV's accommodated in the service road and waiting to enter the yard could be moved forward to access the loading dock. This servicing protocol would allow up to 9-10 HGV's to be loaded before any need would rise to allow any to exit via the HCA bridge. It is considered that the time needed for loading this many vehicles would be similar or greater to the 'window' safety time of 20-30 minutes needed for a large crowd to leave the venue and disperse. As such, conflict and safety issues would be avoided, whilst the operators servicing requirements in terms of post-event demobilisation would be satisfied.

This 'stacking' arrangement is illustrated in both Drawing Nos. 034070-BA-BHE-TP-ZZ-DR-00-0001 and 034070-BA-BHE-TP-ZZ-DR-00-0002.

It is anticipated that HGV's arriving with equipment and staging for set-up would do so well before the 1-2 hour period before the start of an event. As such, this would avoid any conflict with the bulk of spectators arriving at the venue. Although HGV's arrivals within this 1-2 hour pre-event 'window' are extremely unlikely for the reasoning given above, the operator would need to liaise with the event promotor as required to prevent large service vehicles turning up at this time.

7.4.3 Tour Buses

7.4.3.1 Parking Provision and Exit Arrangements

The drawings in Appendix G show that on-site parking for up to 4 tour buses will be provided in the SE corner of the Arena Island site, and adjacent to the service yard. Unlike the planned regime for HGV's there will need to be procedure in place to allow the exit of one or more tour buses immediately after the event. For highway safety reasons this cannot be via the HCA Bridge, whilst trying to secure exit for the artiste and his/her entourage via the same route being used by the bulk of the departing fans/spectators would create security and other issues as well.

In view of this the planned exit route for tour buses at the end of an event would be via the existing access route on the A4 Bath Road. This route will normally be gated at both the exit from the service yard and in the vicinity of the junction with Bath Road to prevent unauthorised use. Apart from the use for tour bus exit as advocated in this Plan, this access will be restricted to emergency vehicle use only.

Marshalling of the access road will be put in place at the end of an event to:

- Open and secure gates. HGV's will not be allowed to use this route after an event;
- Liaise with the BCC Traffic Control Centre (TCC) to introduce all 'all red' stage in the signal sequence at Three Lamps. This will be needed to create a suitable 'gap' in the northbound traffic on the A4 Bath Road to enable safe egress for one or more tour buses or mini-buses leaving the venue; and
- Move-on any spectators waiting in the access road near the Bath Road junction.

7.5 Emergency Access

Emergency vehicle access will be available at the site from two locations. To the north of the site via the HCA bridge and to the west of the site via the existing access from the A4 Bath Road. The height clearance of the access via the A4 Bath Road has been checked for use with emergency vehicle heights (with a fire engine being the tallest vehicle) and no issues exist.

Drawing No. 034070-BA-BHE-TP-ZZ-DR-00-0004 shows the routes that emergency vehicles would be able to use to both access Arena Island, and also to get to specific points around the Arena building.

7.6 Parking

7.6.1 Vehicle Parking

The detailed application for the Arena (Phase 1) includes 200 car parking spaces for operational purposes and 45 disabled user spaces. The outline application for the final form of development (Phase 2) would retain the disabled spaces, whilst the operator's parking would be moved to another site.

7.6.2 Cycle Parking

Cycle parking (252 spaces) will be provided within the site and will include a combination of sheltered and open cycle parking located in close proximity to the main Arena building. These will be highly visible locations, enabling employees and visitors to park close to the building. Of the spaces provided 20 will be for staff in a separate location.

The BCC cycle parking standards do not extend to include Arena sites, however standards from other local authorities suggest cycle parking provision in the range of 200 spaces. The Arena is therefore intending to provide cycle parking capacity of this magnitude.

SECTION 8

Trip Generation and Distribution

8.1 General

This chapter identifies:

- The trip generation by all modes associated with various sized Arena events in terms of both visitors and staff;
- The likely 'catchment' area associated with visitors to the Arena, and how traffic is likely to distribute and assign to various routes into the City Centre;
- The expected travel mode splits under a 'worst case' scenario on a weekday/Saturday evening and Saturday day-time, assuming no event specific measures are put in place to improve travel choice;
- The expected trip generation and distribution pattern associated with Arena staff;
- The assumed arrival profiles prior to different events used in analyses, and similarly the departure profiles; and
- The expected traffic generations associated with the Phase 2 Arena Island developments covered in the Outline planning application.

As mentioned above, the visitor mode split figures presented do not take any account of any additional public transport or other transport measures that might be put in place for specific events to encourage sustainable travel and thus discourage car trips into the City Centre.

8.2 Arena Visitors

8.2.1 Catchment Area

The typical geographic area from which people will be prepared to travel to attend an event at the Arena venue is referred to as the Arena's catchment area. The exact catchment area associated with a given event occurring at the Arena may vary due to a number of influences. For example, if an artist is performing in Bristol and other nearby venues, for example Cardiff, the catchment area of the event may be relatively local. However, if an artist is playing only a limited number of UK venues, then the catchment area will be significantly greater if the Bristol venue is selected as one of these locations.

The catchment area of the event will also be affected by the nature of the show, the number of event dates performed on the tour and the time at which the event is being held. From experience, the Bristol Arena operator has suggested 60-90% of the audience would come from within a 40 minute drive of Bristol.

Within the Bristol Arena - Stage 1 Feasibility Report dated 21 September 2012, it was identified that Arenas and large scale rock/pop venues, typically draw attendance from a drive-time catchment of 60 minutes. As Bristol faces competition for events held geographically in the southwest, and also potentially extending north and east towards Birmingham and London respectively, the 60 minute drive time was considered to be a realistic visitor catchment. Identified from a number of factors, including disposable income levels and type of employment, this catchment definition was also used in the business case for the Arena development. This catchment area journey time is also consistent with other TA's prepared for UK Arena sites, most recently the Leeds Arena planning application on 2009.

There are approximately 935,000 people that reside within a 30 minute drive time of the proposed Arena site, with 2.8 million people residing within a 60 minute drive time. The large catchment area within Bristol and its demographic profile suggests a strong potential to attract events and audiences to a new Arena site.

8.2.2 Gravity Model Distribution

A population / distance gravity model has been used to identify a typical distribution of trips to/from the Arena based on a 60 minute drive time, utilising population areas from Census. The 60 minute drive time has been identified using GIS mapping that takes account of existing traffic conditions within Bristol during a weekday afternoon period. As such, the catchment area is considered to cover a robust geographical area, but also reflects the fact that not all Arena trips will be travelling during a peak hour period.

Figure 8.1 shows the extent of the gravity model (catchment area boundary) based on journey times plots. This figure also shows the primary routes used to access the centre of Bristol from the following areas identified lying within the 60 minute drive time catchment.

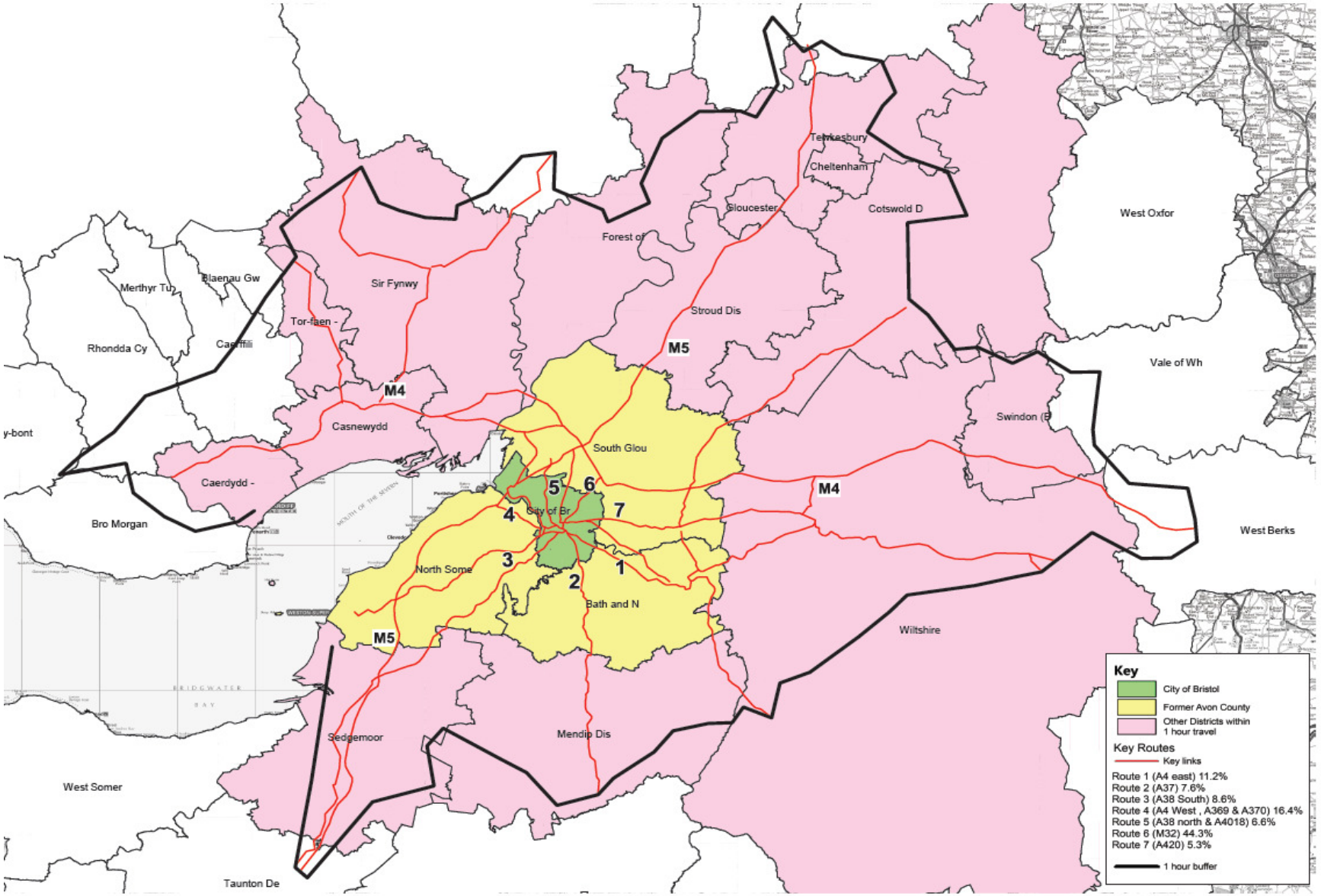
- City of Bristol;
- Bath and North East Somerset;
- North Somerset;
- Abergavenny;
- Torfaen;
- Newport;
- Cardiff;
- Sedgemoor;
- Mendip District;
- Stroud District;
- Forest of Dean;
- Gloucester;
- Cotswold District;
- Cheltenham;
- South Gloucestershire;
- Swindon;
- Tewkesbury; and
- Wiltshire (part)

A weighting coefficient of 1.5 was applied to the population within the City of Bristol to give an assumed greater likelihood of 'local' attendance by residents in the city.

8.2.3 Vehicle Trip Assignment

A broad assignment was identified for Arena visitors, although specific route choice is considered in detail by the GBATS traffic model discussed earlier. Vehicle trips were assigned via the primary routes connecting population origins to a central Bristol destination. Destinations largely include City Centre, public car parks, St Philips Marsh Area and pick-up / drop-off locations.

Figure 8.1: Bristol Arena visitor catchment area and key travel routes



Arena visitors were assigned over the highway network based on the 'most suitable' routes people would use to access the city centre. These include the major signed routes and roads offering the most favourable journey times. Trip origins were paired to routes, and where it was considered that more than one route could be used, the district origin area was broken down into smaller ward areas and assigned to a route on that basis.

Wiltshire, representing a large district in terms of geographical area, has been broken down into individual ward areas, with only those identified within a 60 minute journey time (drive time) of the Arena being selected. The same has been undertaken for the Cotswold District, as only half of this area is identified to fall within the 60 minute journey time of the site. All other District areas are included in full.

Figure 8.2 shows the expected proportions of car-occupant visitor trips expected to arrive in Bristol using various routes based on a 'most likely' manual assignment principle, although as noted above the application of the GBATS gives some latitude to vary this slightly in the highway modelling. The key thing to emerge was the high proportion of visitors expected to arrive from the north via the motorway network and the M32.

8.2.4 Mode Split

8.2.4.1 General

The mode split percentages determine the volume of people that will use a particular mode of transport to access the Arena site, with a number of factors playing a consideration in this choice. As noted earlier, the nature of the development has the potential for a significant number of visitors to be drawn to the site, from both a local and widespread geographical area. This in turn influences travel choices available to these visitors. Arena visitors originating from outside the City of Bristol are more likely to travel by more strategic transport options, such as rail, car or park & ride (subject to these being available), given the distance, cost and journey time implications for accessing the site. Local Arena visitors having a much shorter distance to travel and being more familiar with local transport options, would have a greater potential for accessing the site by walking, cycling and via local bus services. However, for the purposes of assessment in the TA a single mode split has been determined for different time periods, and not 'local' and 'longer distance' versions. This is because whilst the proportion of local to longer distance visitors will inevitably vary with different events, it was necessary to consider a typical situation for assessment purposes. In this respect, the percentages expected to walk/cycle or use local buses will reflect the proportion of local visitors, who will have this choice.

8.2.4.2 Calculation of Mode Splits: Late Evening Events

An advantage of Bristol being one of the last UK cities to build an Arena is that there are a number of examples available in which to understand how people will travel to and from the site. The Leeds (First Direct) Arena is the most recent similar sized Arena to have been built in the UK, and it's TA prepared by Arup in 2009 included surveyed mode splits for a series of other similar sized venues. Mode splits for the Bristol Arena have therefore been drawn from surveys at Arena venues that have preceded it, including Manchester, Leeds and another anonymous UK Arena site, understood to be the Capital One Arena in Nottingham.

An average of available values have been calculated and refined to ensure mode splits total 100%. Mode split data identified for the three Arena sites are presented in **Table 8.1.**

Figure 8.2: City Centre: Indicative traffic assignment routes and distribution proportions

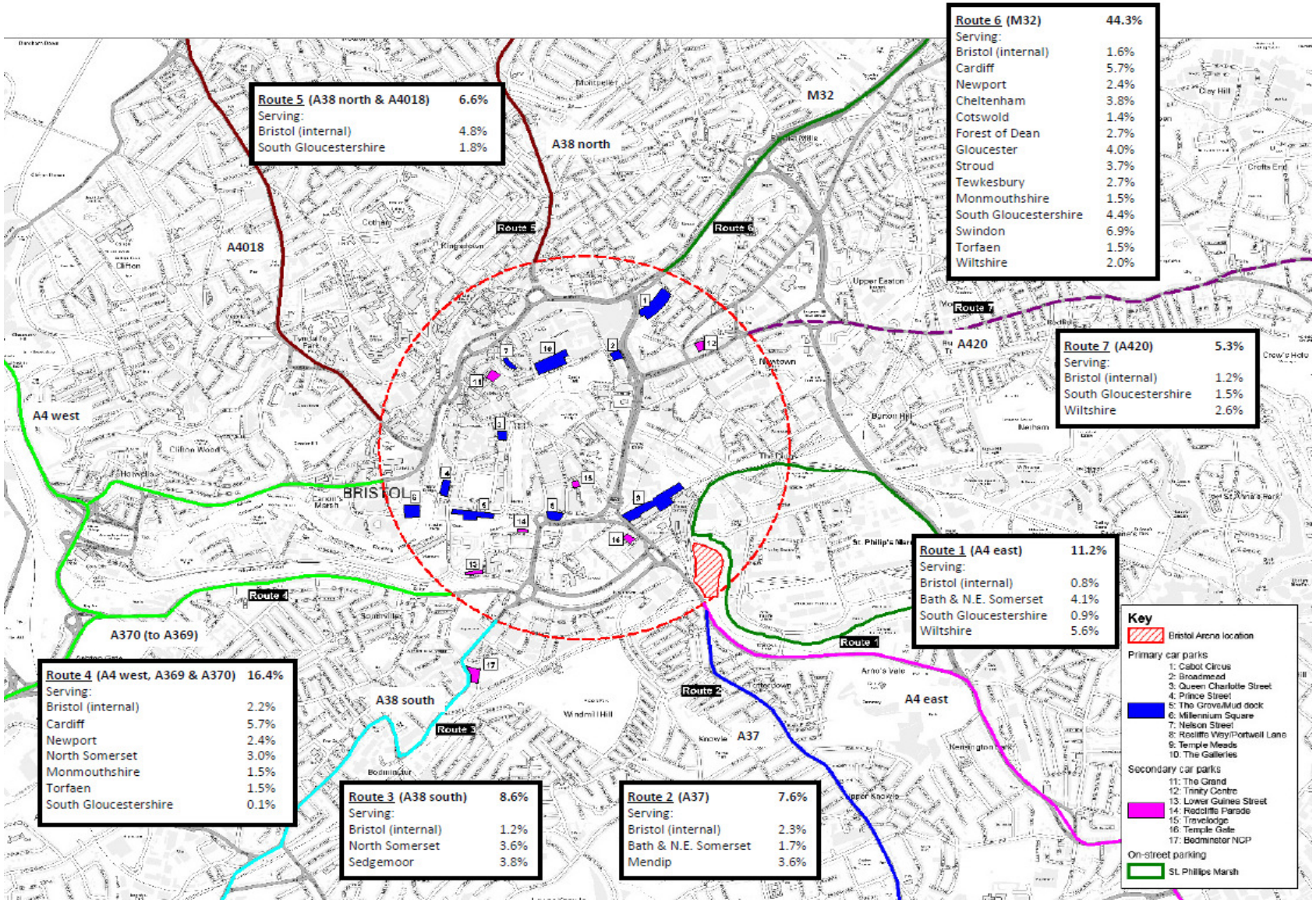


Table 8.1 Visitor mode split percentages for an evening event - Weekday/Saturday

Journey mode	MEN Arena, Manchester	Other UK City Arena	Leeds First Direct Arena	Bristol Arena (BASE-LINE Assumption)
Car Occupant	80%	74%	80%	75%
Park & Ride	-	-	-	0%
Bus	7%	4%	4%	5%
Coach	-	-	2%	2%
Rail / tram	13%	11%	5%	9%
Taxi	-	7%	6%	6%
Walk / Cycle	-	4%	3%	3%
Total	100%	100%	100%	100%

These other existing Arena sites are considered to be a suitable comparison for the following reasons.

- MEN Arena, Manchester - is a 19,000 capacity arena in the north of the city centre. The Arena has excellent public transport accessibility with bus, tram and rail links within a few minutes' walk. There is a 900 space car park (including 58 disabled spaces) on site with a number of other city centre car parks within a short walking distance;
- Major UK Arena (Nottingham) - a 10,000 seat capacity venue on an edge of city centre location and identified to be comparable to the Leeds Arena. Public transport accessibility to the site is good with bus and positioned within approximately 1km of the city centre railway station. Visitor surveys were undertaken between 2001 and 2004 and identified mode share for different events; and
- First Direct Arena, Leeds - a 13,500 capacity Arena situated on the northern edge of the city centre. This newest UK Arena opened in July 2013. Whilst Leeds railway station has a larger catchment area compared to Bristol Temple Meads railway station, this is positioned over 1km from the Arena site, on the opposite side of the City Centre.

These Arenas were considered to be a good match for informing the likely trip generation associated with the current proposals, although mode splits have been tailored to reflect site specific differences. Taking into account the good accessibility available to the Temple Meads area it is considered that Bristol can achieve accessibility on par to other UK Arenas, and therefore the mode share percentages would also be similar, however some amended mode-split assumptions were made for the following reasons:

- The Bristol Arena is positioned close to Temple Meads Railway Station although, without rail service enhancements for evening events, limited train services would be running at the times at which events would end. In contrast, Manchester Railway Stations (including tram) serve a greater catchment of destinations, which would influence mode splits associated with the site. A such, it was considered that the rail mode split for Bristol be revised down to take into account these characteristics in a 'worst case' scenario; and
- Few other UK cities can compare to Bristol in terms of P&R provision, with this service having a significant influence on travel in the city. However, whilst P&R will play a key role in accessing the Arena site for events occurring through the morning, afternoon and early evening on a Saturday, this service is not currently available to provide this option for visitors attending events occurring late on a weekday or Saturday. Therefore, the P&R mode split (at zero) is comparable to the other UK Arena examples in a 'worst case' scenario, without some event specific interventions to extend operation.

The final 'worst case' mode splits used for assessment in **Table 8.2** below show the rail proportion reduced by 5%, with a corresponding increase in car occupants. These results are considered to better reflect the current possibilities for travel to events in Bristol with a late evening finish, whilst still retaining the mode split results typical of other UK Arena sites. Taxi trips have been reduced by 4% as the other UK Arena examples are likely to have a higher proportion of taxi trips between the railway station and the Arena site, whereas Arena Island is situated within a short walking distance of Temple Meads Railway Station. It should also be noted that Bristol has the highest cycling rates of any major UK city at circa three and a half times the average, so assuming an uplift in the walk/cycle mode was considered more than reasonable.

Table 8.2 Revised Visitor Mode Split percentages for an evening event - Weekday/Saturday

Vehicle Mode	Baseline mode split	Revised Mode split - Final (%)	Percentage change
Car Occupant	75%	80%	+5%
Park & Ride	0%	0%	-
Bus	5%	5%	-
Coach	2%	2%	-
Rail	9%	4%	-5%
Taxi	6%	2%	- 4%
Walk and Cycle	3%	7%	+4%
Total	100%	100%	100%

8.2.4.3 Calculation of Mode Splits: Saturday Daytime Events

For Saturday day-time matinee events, the potential for travel to and from the Arena site by public transport is significantly increased compared to a weekday evening situation, with the full extent of P&R, bus and rail services in operation and covering event start and finish times. As such, the potential for journeys to be made by non-car modes is also increased. Mode split percentages have been discussed and agreed with BCC Transport Development Management for Saturday family events and these are set out below in **Table 8.3**. For comparison purposes the vehicle occupant mode share for weekday journeys to work to this part of the City Centre is around 48%.

Table 8.3 Visitor Mode Split percentages for a Saturday matinee

Vehicle Mode	Saturday mode split percentages calculated
Car Occupant	65%
Park & Ride	5%
Bus	10%
Coach	2%
Rail	11%
Taxi	2%
Walk and Cycle	5%
Total	100%

8.2.5 Vehicle Occupancy

In terms of traffic generation the above mode split assumptions give the number of 'car occupants', so not the number of expected vehicles. Given the nature of the Arena proposals, coupled with the 'social' aspect of the destination, groups of people are more likely to travel together to/from the venue.

For car travel, an average car occupancy rate of 2.7 has been accepted for the Leeds Arena TA, and this has been derived from surveys undertaken at the MEN Arena car park. The Leeds TA also states that this has been validated against other Arena venues, including the NEC in Birmingham and the Liverpool Echo Arena.

Whilst there are no Arena sites within the TRICS database, trips to a theatre were identified to be the closest representation, and could better reflect smaller events occurring at the Arena. TRICS identifies a car occupancy rate of 1.85 in this case. Taking into account the two figures, an average car occupancy of 2.4 has been used for visitors during an evening event on both a weekday and Saturday, accepting that for the most part these may be larger events

For the smaller, family oriented events held on a Saturday daytime, a car occupancy of 2.7 people has been identified, to reflect an established family size arriving for the event.

For coach travel, the majority of event type coaches can accommodate approximately 55 people at full capacity. A coach occupancy of 30 people has been used to reflect that not all coaches may be fully occupied, and that coach sizes do vary. An occupancy rate of 30 people per coach is considered to be a realistic assumption for coach travel. This, together with the coach mode split, has been used to estimate the typical number of coaches expected at different size events. However, it is accepted this could vary depending on the nature of the event and the main target demographic group.

8.2.6 Linked trips

Car trips allied with other journey purposes in the city are identified as 'linked' trips. This includes people travelling directly from work in the City Centre to weekday evening events, or people choosing to visit the Arena when already shopping / visiting the city on a Saturday. It is believed that using a value of 10% for 'linked trips' is a robust assumption for these journeys, when transport evidence suggests that retail and leisure trips can command much greater values. It is not unusual for people intending to visit a City Centre for shopping or to meet friends, to also check what other events are occurring in the city on the same day and attend these as part of the city visit. As such, these trips are assumed to be cars already parked in the city centre / friends' houses, and are not taken as car trips making a specific journey to the Arena.

The linked trip percentage has been applied to car trip journeys made to and from the Arena in assessing net parking requirements and highway operation.

8.2.7 Events Type and Scale

8.2.7.1 Annual Number and Typical Attendances

The number of visitors attending an event depends on two primary aspects, the scale of the event and its attendance capacity. The type and scale of events has been identified from the BCC report titled 'Arena Outline Business Case'. Taken from this report, **Table 8.4** sets out an indicative event programme for the Arena.

Table 8.4 Indicative event programme

Event type	Year 1	Year 2	Year 3	Year 4	Year 5
Concerts					
Major rock / pop concert	14	16	18	18	18
Medium rock/pop concert	13	14	15	15	15
Minor rock/pop concert	10	12	16	16	16
Classical concert	3	3	4	4	4
Sports events					
sport - anchor tenant	0	0	0	0	0
sport - major event	1	2	2	2	2
Sport - other	2	3	4	4	4
Entertainment					
Family shows	18	19	20	20	20
Musicals/theatre	6	7	8	8	8
Comedy	8	10	12	12	12
Other					
Dance shows	1	1	2	2	2
Community events	1	1	1	1	1
Exhibitions	2	2	4	4	4
Conferences	2	2	2	2	2
Banquets / weddings	2	3	4	4	4
Other events	2	3	4	4	4
TOTAL	85	98	116	116	116

Source: Table 10.2 Indicative event programme Option 1a (12k horseshoe lease model)

The table concludes that by year 3 the Arena is likely to have established its visitor catchment and be operating at its full potential. This would see 116 events (approx.) per annum, consisting of music, entertainment, sports and exhibitions. The programme identifies 18 major events (assuming full capacity) occurring per annum, although the Arena operator has suggested that this would be closer to 20 events. Event capacities are identified in **Table 8.5** below.

Table 8.5 Average event capacities

Event type	Event capacity	Average % sold	Average attendance per event
Concerts			
Major rock / pop concert	12000	90%	10800
Medium rock/pop concert	10000	85%	8500
Minor rock/pop concert	8000	75%	6000
Classical concert	6000	75%	4500
Sports events			
sport - anchor tenant	8600	25%	2150
sport - major event	9700	90%	8730
Sport - other	9700	50%	4850

Event type	Event capacity	Average % sold	Average attendance per event
Entertainment			
Family shows	5000	80%	4000
Musicals/theatre	5000	80%	4000
Comedy	10000	70%	7000
Other			
Dance shows	6000	80%	4800
Community events	5000	75%	3750
Exhibitions	5000	65%	3250
Conferences	2000	75%	1500
Banquets / weddings	2000	75%	1500
Other events	5000	75%	3750

Source: Table 10.5 Average event capacities and attendances option 1a (mature year)

Taking account of the broad range of event types identified by the programme, the average visitor attendance per event is approximately 6,200 visitors, with all events attracting a range of 2000 to 12000 people. Whilst various types and sized events will occur throughout the year it was agreed with BCC Transport Development Management that a 'maximum capacity' event should be considered for the purpose of car trip generation (12,000 visitors), in order to determine the impact this level of traffic would have on the adjoining highway network and parking supply.

8.2.7.2 Event Timing

There is no set pattern for an event occurring at an Arena. Given the bespoke nature of the land use, and the venues operation needing to remain flexible in attracting and accommodating artists, activity and hours of operation can vary on a daily and weekly basis. Considering how UK Arenas operate, it is typical for an Arena venue to open early to maximise the sale of merchandise for large scale pop events. Events such as 'Last night at the Proms' will finish late into the evening, whereas family events will typically occur several times during the day.

There are certain periods of the day when the Arena will be more regularly used. Based on a review of the days and times in which other UK Arenas operate, it is typical for large events to begin between 1900 and 2000 during an evening and finish between 2200 and 2300. This Information was originally drawn from the Leeds Arena TA. This TA includes a significant evidence base used to identify the typical operation of Arena sites, utilising surveys undertaken at the Manchester Evening News (MEN) Arena and another UK Arena. Surveys indicated an average start time for weekday Arena events as 1930. The Bristol Arena operator has since confirmed this start time as being accurate, and has suggested a finish time of 2300 (although it is noted that times could vary depending on the type of event occurring).

Matinee events running on a Saturday will include family shows such as 'Disney on ice' or 'CBeebies live'. These could be held up to 3 times a day on a Saturday, with anticipated start times at 1100, 1500 and 1900 hours Matinee events attract between 3000 and 6000 attendees, with 6000 representing a sell-out (maximum capacity) attendance. These events typically run for a 2.5 hour duration, with a 15-20 minute interval included.

Other smaller exhibitions and conferences are likely to be held at the Arena during the week and at weekends, although these will be significantly more limited in terms of trip generation.

In view of the above the 'worst case' traffic generation analyses have examined a 12,000 maximum and 6,000 average event occurring on a weekday evening and a Saturday evening, with the Saturday matinee or daytime events looking at 4,000 and 6,000 attendances.

8.2.8 Visitor Traffic Generation: Worst Case

8.2.8.1 Weekday and Saturday Evening

Tables 8.6 and 8.7 show the calculated trip generation associated with a late evening maximum and average capacity event at the Arena and assumptions for vehicle occupancy.

Table 8.6. Weekday/Saturday Evening: Journey Mode Splits

Journey mode	Bristol Arena mode share percentages	Maximum capacity event (12000 attendees)	Average capacity event (6000 attendees)
Car	80%	9600	4800
Park and Ride	0%	0	0
Bus	5%	600	300
Coach	2%	240	120
Rail	4%	480	240
Taxi	2%	240	120
Walk and Cycle	7%	840	420
Total	100%	12000	6000

Table 8.7. Weekday/Saturday Evening: Vehicle Occupancy Levels

Mode	Occupancy levels	Maximum capacity event vehicle trips	Average capacity event vehicle trips
Car	2.4	4000	2000
Taxi	2.4	100	50
Coach	30	8	4
Total Vehicles		4108	2054

Note: Linked trip reductions excluded

8.2.8.2 Saturday Day-Time

Information on Saturday family events during the day has been obtained from the Bristol Arena operator. As for a weekday/Saturday late evening event, there is no particular set start time and duration for events, but for the purpose of assessment in this TA, suitable assumptions have been identified. These include:

- Family events would occur 6 - 12 times per annum, and include events such as Disney-On-Ice, CeBeebies Live, etc;
- Family events would occur three times a day starting and finishing approximately 1100-1330 / 1500-1730 / 1900-2130;
- Family events would occur for a period of 2 hours, each with a 15min break included. An hour and a half gap is identified between performances, allowing crowds to dissipate before the next event attendees arrive; and

- A maximum of 6000 people are anticipated to attend family events, and 4000 attendees have been identified for an average sized event.

Saturday matinee Arena events would attract significantly fewer attendees than events held in the evening, although Saturday traffic would still coincide with other traffic travelling in and out the city associated with retail, leisure visitors, etc. A Saturday lunchtime period is considered to be the most critical period in which to assess the traffic associated with a Saturday matinee event, both in terms of traffic movements in the city and in terms for car parking demand. The trip generation potential of a Saturday matinee event is set out in **Table 8.8** below, with vehicle occupancy information presented in **Table 8.9**.

Table 8.8 Saturday Daytime Events - Journey Mode Splits and Trips

Journey mode	Saturday mode share percentages	Maximum Saturday family event (6000 attendees)	Average Saturday family event (4000 attendees)
Car Occupant	65%	3900	2600
Park and Ride	5%	300	200
Bus	10%	600	400
Coach	2%	120	80
Rail	11%	660	440
Taxi	2%	120	80
Walk and Cycle	5%	300	200
Total	100%	6000	4000

Table 8.9 Saturday Daytime Event - Vehicle Occupancy levels

Mode	Occupancy levels	Maximum capacity event vehicle trips	Average capacity event vehicle trips
Car	2.7	1444	963
Taxi	2.7	44	30
Coach	30	4	3
Total Vehicles		1493	995

Note: Linked trip reductions excluded

8.3 Staff Trips

8.3.1 Staff Numbers

In identifying trips associated with staff working at the Arena, the overall staffing levels have been identified from the recent Leeds Arena TA, with information validated by the Bristol Arena operator. A similar number of employees are typically required for both weekday and Saturday events. A maximum capacity evening event might require additional security and refreshment staff, whilst a Saturday family event might require a greater number of merchandise sellers. Similar levels of marshals and stage crew are needed for both event types. As such, staff numbers are assumed to be the same for weekday / Saturday evening events and family matinees.

The Leeds Arena TA suggests an event is predicted to require 60 full time staff and 400 event day staff. The Bristol Arena operator suggests 400 staff would typically be required for a large event day. In presenting a robust analysis, 460 staff has been identified for the Bristol Arena site.

8.3.2 Staff Trip Distribution and Assignment

Arena venue staff and those employed by other Arena Island land uses would exhibit a different travel pattern to Arena visitors. For staff the site is a place of employment, so no different to any other work place located on the edge of the city centre. Journey to Work data has been derived from 2011 Census outputs to identify the origin locations of people working at the Arena site. Two Middle Super Output Areas (MSOAs) were used to identify a journey pattern comparison, which excluded the City Centre, but incorporated the location of the site and neighbouring employment areas.

8.3.3 Staff Mode Split

Mode split percentages for staff working at Arena have been based on 2011 Census Travel to Work data for two Middle Super Output Areas (MSOAs) largely covering the population ward of Lawrence Hill (reference 037 and 054), in which to derive a suitable comparison for car trip generation. Calculations have taken out 'working from home' and 'Not Working' percentages, to reflect trips being made to an employment destination.

Staff trips by all modes are set out in **Table 8.10** below.

Table 8.10 2011 Journey to Work Census mode splits and Arena staff predicted trips

Journey mode	2011 Census Journey to work census data percentages	Staff trip numbers per mode
Underground, metro, light rail or tram	0%	0
Train	11%	51
Bus, minibus or coach	12%	55
Taxi	0%	0
Motorcycle, scooter or moped	2%	9
Driving a car or van	43%	198
Passenger in a car or van	5%	23
Bicycle	8%	37
On foot	19%	87
Other method of travel to work	0%	0
Total	100%	460

8.4 Arrival and Departure Profiles

8.4.1 General

A key factor affecting both the parking and highway impact assessments is the period over which visitors are expected to arrive in the City Centre and, when leaving, the period over which this is likely to occur. Information provided initially by the operator suggested that visitors arrive 'at venue' up to 2 hours before an event with, not unexpectedly, circa 70% doing so in the hour before. However, for assessing parking and highway impact it is actual time of arrival/departure in the City Centre that is more important, which may vary on a Saturday compared to a weekday evening.

8.4.2 Arena Staff Trips

As noted earlier a large event will typically employ 460 staff, with food and bar staff, merchandise staff and security / stewards arriving at the site relatively early, whereas make-up artists, costume people, stage crew and musicians would arrive a little later. The profile assumes the majority of staff work approximately 7.5hrs a day, and that the majority of staff are in place one hour prior to the Arena doors opening, which occurs 90 minutes prior to the start of the event. This is considered to be a robust view of staff arrivals, with the majority arriving at times to coincide with the highway network peak periods.

It is expected most Arena staff will depart within 20 -30 minutes of most visitors departing the venue. This typically falls within the 60 minute period after which the event has finished.

8.4.3 Arena Visitor Trips

8.4.3.1 Weekday Evening Events

For weekday evening events, it is assumed visitors could arrive in the city up to 3 hours prior to an event start. With a 1930 event start time identified for most evening events, a proportion can be expected to arrive in the city early to avoid evening peak hour congestion, and may combine the event with a drink or meal beforehand. Local spectators may typically arrive closer to the event time start and so, in the case of weekday events, leave home after the evening commuter peak hour.

8.4.3.2 Saturday Evening Events

The assumed profile is similar to a weekday evening, but with slightly more spectators assumed to arrive in the city centre three hours before an event to provide more time to combine the Arena attendance with other activities such as pre-event shopping, food, drinks, etc. The arrival/departure profile also reflects a lesser constraint on arrival times on a Saturday related to work.

8.4.3.3 Saturday Daytime Events

These include events beginning during the morning and finishing during the early evening. Spectators attending a morning performance starting at 11:00am will typically have a shorter arrival period than 3 hours and spend limited time in the City Centre before the event. The majority are assumed to arrive 2 hours prior to the event, to give some margin to take account for travel delays and sufficient time to get to the Arena site with children in tow.

The assumed and agreed arrival and departure profiles for staff and visitors for each event scenario is set out below in **Figure 8.3** below.

Figure 8.3 Arena visitor and staff arrival and departure profiles

Weekday Evening				Event start	Event finish		
	-3hr	-2hr	-1hr	1930	2300	+1hr	+2hr
Visitors	30%	30%	40%			100%	
Staff	70%	20%	5%	5%		80%	20%

Arena doors open 90 mins prior to event start

staff largely arrive 1 hour prior to doors opening

Saturday Evening				Event start	Event finish		
	-3hr	-2hr	-1hr	1930	2300	+1hr	+2hr
Visitors	40%	40%	20%			100%	
Staff	70%	20%	5%	5%		80%	20%

Saturday Matinee (AM)				Event start	Event finish		
	-3hr	-2hr	-1hr	1100	1330	+1hr	+2hr
Visitors		70%	30%			60%	40%
Staff	70%	20%	5%	5%		80%	20%

Saturday Matinee (Afternoon)				Event start	Event finish		
	-3hr	-2hr	-1hr	1500	1730	+1hr	+2hr
Visitors	40%	40%	20%			100%	
Staff	70%	20%	5%	5%		80%	20%

Saturday Matinee (PM)				Event start	Event finish		
	-3hr	-2hr	-1hr	1900	2130	+1hr	+2hr
Visitors	40%	40%	20%			100%	
Staff	70%	20%	5%	5%		80%	20%

When 3 mattinee events occur, staff only to arrive for first event and depart after the last event

8.5 Arena Island Developments - Phase 2

8.5.1 Proposed Land Uses

As noted earlier the outline planning application proposes 'other' land uses for the Arena Island site in Phase 2. This includes:

- 8,200sqm commercial office development (B1 land use class);
- 1,400sqm commercial A3 / A1 land use classes; and
- 9,400sqm of residential use (C3 land use class). The residential floor-space as described in the Masterplan would accommodate 64 two bedroom apartments and 16 one bedroom flats (80 units).

8.5.2 Traffic Generation

The A1/A3 developments are intended to largely support the Arena venue and outside event times would be expected to generate a negligible amount of traffic, certainly in the weekday peak hours. The office and residential land uses will generate most vehicle traffic outside typical event times in the weekday peak hours although, as indicated above, the residential component will be small in terms of the number of units.

Table 8.11 and **Table 8.12** set out the arrival and departure profiles of both residential and office development over the weekday 0700 to 1900 period, as derived from TRICS City Centre survey sites. **Table 8.13** and **Table 8.14** presents the weekday trip generation for the Arena proposals for each of these land uses. As expected, most car trips will be associated with the commercial office component. However, any office employees with available parking on the Arena Island site will have largely left before 1800, so creating a minimal conflict with visitors arriving for an event on a weekday evening.

Table 8.11: Car arrival / departure profile from TRICS for C3 Residential City Centre sites

Time Period	Arrival Profile	Departure Profile
0700 to 0800	5%	13%
0800 to 0900	5%	15%
0900 to 1000	5%	9%
1000 to 1100	7%	7%
1100 to 1200	5%	4%
1200 to 1300	4%	4%
1300 to 1400	7%	8%
1400 to 1500	5%	7%
1500 to 1600	7%	3%
1600 to 1700	17%	9%
1700 to 1800	21%	14%
1800 to 1900	13%	7%
TOTAL	100%	100%

Table 8.12: Car arrival / departure profile from TRICS for B1 office: City Centre sites

Time Period	Arrival Profile	Departure Profile
0800 to 0900	23%	3%
0900 to 1000	17%	5%
1000 to 1100	10%	6%
1100 to 1200	7%	6%
1200 to 1300	7%	6%
1300 to 1400	6%	6%
1400 to 1500	5%	6%
1500 to 1600	4%	12%
1600 to 1700	3%	20%
1700 to 1800	2%	24%
1800 to 1900	1%	5%
TOTAL	100%	100%

Table 8.13: Office trip generation based on 8,200sqm GFA

Time Period	Arrival Trip Rate	Trips	Departure Trip Rate	Trips	Total Trip Rate	Trips
0700 to 0800	0.345	28	0.016	1	0.361	30
0800 to 0900	0.574	47	0.062	5	0.636	52
0900 to 1000	0.427	35	0.11	9	0.537	44
1000 to 1100	0.241	20	0.154	13	0.395	32
1100 to 1200	0.17	14	0.148	12	0.318	26
1200 to 1300	0.162	13	0.146	12	0.308	25
1300 to 1400	0.146	12	0.145	12	0.291	24
1400 to 1500	0.119	10	0.145	12	0.264	22
1500 to 1600	0.101	8	0.293	24	0.394	32
1600 to 1700	0.082	7	0.482	40	0.564	46
1700 to 1800	0.048	4	0.569	47	0.617	51
1800 to 1900	0.034	3	0.128	10	0.162	13

Table 8.14: Residential trip generation based on 80 flats/apartments

Time Period	Arrival Trip Rate	Trips	Departure Trip Rate	Trips	Total Trip Rate	Trips
0700 to 0800	0.02	2	0.059	5	0.079	6
0800 to 0900	0.022	2	0.07	6	0.092	7
0900 to 1000	0.022	2	0.042	3	0.064	5
1000 to 1100	0.028	2	0.031	2	0.059	5
1100 to 1200	0.02	2	0.017	1	0.037	3
1200 to 1300	0.017	1	0.02	2	0.037	3
1300 to 1400	0.028	2	0.036	3	0.064	5
1400 to 1500	0.02	2	0.031	2	0.051	4
1500 to 1600	0.028	2	0.014	1	0.042	3
1600 to 1700	0.073	6	0.042	3	0.115	9
1700 to 1800	0.087	7	0.067	5	0.154	12
1800 to 1900	0.053	4	0.034	3	0.087	7

Full TRICS results are presented in **Appendix H.**

The TRICS data predicts that the expected traffic generation associated with the flats will be negligible, whilst this assumes that parking will be provided which may not be the case. As the Phase 2 planning application is Outline the level of parking which will be provided on-site for the offices is also unknown. However, discussion with BCC Transport Development Management indicates that there is a general desire to restrict office parking in this area, and that likely maximum provision would be based on one space per 300sqm GFA. This would give a maximum parking provision of only 27 spaces for the commercial office provision here.

The effect of any constrained office parking will have a big impact on the actual car trip generation locally. The direct application of the TRICS figures in Table 8.13 show that, if occurring, this local traffic generation would result in a maximum parking accumulation of 104 vehicles, with parking demand over 85 vehicles sustained from 0900 to 1600. Assuming only 27 spaces are made available, the proxy reduction in expected office related vehicle trips here would be nearly 75%. As such, the two-way

vehicle flows in the two peak hours would be circa 15 trips only. In view of this the overall traffic impact of the Phase 2 developments can be expected to be negligible with expected maximum parking controls applied.

SECTION 9

Car Parking Demand Assessment

9.1 Agreed Approach

Discussions have been held with BCC Development Management on the approach to be taken in considering the impact of Arena visitors on car parking supply. Officers advised that the TA should consider a worst-case scenario for car parking demand.

On this basis, the assessment parameters used to assess car parking demand have been identified to reflect robust testing. These include:

- 'Worst' Case' vehicle mode splits of 80% car have been used for weekday and Saturday evening events. These currently reflect the limited availability of public transport opportunities for departing the site after a 2300hr event finish. Whilst the full range of rail, P&R and bus services are available to arrive at the site earlier in the evening, these are restricted late into the evening;
- Saturday daytime mode splits reflect the full range of public transport opportunities for accessing the site, and car parking demand is shown to reflect this provision;
- No assumptions have made for mode shift associated with any event-specific measures put in place to improve sustainable travel choice;
- Car parking supply assumptions only make reference to fixed/known car parking provision. No assumptions to be made for other private or third party land owners providing car parking for the Arena site during an event.

Other parameters used in the analysis include:

- A modest 2% of vehicle trips are assumed to be pick-up and drop-off movements. These will be car trips traveling on the highway network but will not require a parking space; and
- As noted in an earlier chapter, 10% of car trips are assumed to be 'linked' trips with other journey purposes. As such, these are assumed to be cars already parked in the city centre/friends' houses, and not new car trips associated with the Arena.

9.2 Event Scenarios

The following Arena event scenarios have considered for car parking demand purposes:

- A weekday average event of 6000 people;
- A weekday evening event of 12000 people;
- A Saturday average event of 6000 people;
- A Saturday evening event of 12000 people; and
- Two Saturday family matinee events of 6,000 (maximum) attendees. One starting at 1500 but with parking accumulation associated with the earlier 1100 event already in place.

9.3 Car Parking Demand

9.3.1 Arena Visitors

Car parking demand associated with these event scenarios has been identified from the trip generation parameters set out earlier in this TA. A summary of calculations is presented below in **Table 9.1.**

Table 9.1 Expected car parking demand for selected event scenarios

Scenario	Capacity	Car Occupant split	Vehicle occupancy	Linked trips & drop off	Staff car trips	Total cars parking (excluding staff)
Average weekday evening	6000	80%	2.4	12%	198	1760
Maximum weekday evening	12000	80%	2.4	12%	198	3520
Average Saturday evening	6000	80%	2.4	12%	198	1760
Maximum Saturday evening	12000	80%	2.4	12%	198	3520
Saturday daytime family matinee	6000	65%	2.7	12%	198*	1271

**Staff trips arrive for the first matinee event and leave after the last event (source: Bristol Arena operator)*

9.3.2 Staff Parking

An Arena event will employ up to 460 staff, consistent across large evening events and Saturday matinees. Based on 2011 'Travel to Work' census data, 198 parking spaces are required based on expected vehicle trip numbers. With no employee parking available on Arena Island these staff trips have been added into car parking demand calculations.

9.4 Assessment of Future Car Parking Levels

Car parking demand associated with the various Arena event scenarios is set out below In **Tables 9.2** to **9.6**. This has been provided for (P) Primary car parks and (A) All car parks which includes both primary and secondary car parks. On street car parking availability at St Philips Marsh has also been included in the 'All Parking (A)' supply for the weekday and Saturday evening scenarios. Whilst parking here will not be encouraged or signed, it is expected that visitors will nevertheless try to park here given the proximity of this area to Arena Island.

The tables in each case show:

- The number of parking spaces occupied in each half hour period (over the respective arrival profile timeframes). As noted above this is shown for both the Primary car parks and all car parking (including on-street in St Phillips). Arena trips are those arriving by car and requiring a parking space in that half hour period, and include both staff and employees; where
- Cumulative columns show existing and Arena trip demand in each time interval, inclusive of car parking spaces taken up in the preceding time periods. This indicates what spare capacity exists in terms of parking space availability during that half hour period, where 100% utility would be none; and
- Final columns show how occupied car parks will be as a percentage, considering both primary and all car park space availability.

9.4.1 Weekday Evening: 6,000 Capacity Event

Table 9.2: Weekday Evening (Average capacity event)

Time Period	Existing Occupied Spaces P	Existing Occupied Spaces A	Arena Trips in Period	Cummul. Occupied Spaces P	Cummul. Occupied Spaces A	Car Park Occup. P	Car Park Occup. A
1630-1700	3488	4197	336	3824	4532	76%	71%
1700-1730	3488	4072	336	4159	4743	83%	75%
1730-1800	2873	3347	284	3829	4303	77%	68%
1800-1830	2258	2624	284	3498	3865	70%	61%
1830-1900	1777	2108	357	3374	3706	67%	58%
1900-1930	1290	1587	357	3245	3542	65%	56%

The table shows that demand associated with a 6000 event on a weekday evening could be easily accommodated by spare capacity available in the primary off-street car parks alone

9.4.2 Weekday Evening: 12,000 Capacity Event

Table 9.3: Weekday Evening (Maximum Capacity Event)

Time Period	Existing Occupied Spaces P	Existing Occupied Spaces A	Arena Trips in Period	Cummul. Occupied Spaces P	Cummul. Occupied Spaces A	Car Park Occup. P	Car Park Occup. A
1630-1700	3488	4197	600	4088	4796	82%	76%
1700-1730	3488	4072	600	4687	5271	94%	83%
1730-1800	2873	3347	548	4621	5095	92%	80%
1800-1830	2258	2624	548	4554	4921	91%	78%
1830-1900	1777	2108	709	4782	5114	96%	81%
1900-1930	1290	1587	709	5005	5302	100%	84%

As expected, a larger event occurring during a weekday evening will place much greater demand on car parking supply in the City Centre. The results suggest that parking demand generated by a maximum 12,000 capacity event could only just be accommodated by spare capacity in primary City Centre car parks, but easily when all other parking is taken into account.

9.4.3 Saturday Evening: 6,000 Capacity Event

Table 9.4: Saturday Evening (Average Capacity Event)

Time Period	Existing Occupied Spaces P	Existing Occupied Spaces A	Arena Trips in Period	Cummul. Occupied Spaces P	Cummul. Occupied Spaces A	Car Park Occup. P	Car Park Occup. A
1630-1700	3488	4197	336	3824	4532	76%	71%
1700-1730	3488	4072	336	4159	4743	83%	75%
1730-1800	2873	3347	284	3829	4303	77%	68%
1800-1830	2258	2624	284	3498	3865	70%	61%
1830-1900	1777	2108	357	3374	3706	67%	58%
1900-1930	1290	1587	357	3245	3542	65%	56%

On a Saturday evening, the parking demand associated with an average capacity event of 6000 people can be accommodated in the primary off-street car parks identified. A maximum utility of 83% is reached at 1700-1730.

9.4.4 Saturday Daytime: Family Matinee Event of 6,000 Attendees

This assessed scenario includes three family matinee events occurring between the hours of 1100-1330, 1500-1730 and 1930-2100. Each of these events is assumed to have a maximum capacity of 6000 attendees. Whilst these are smaller events than identified for evening periods at the venue, there would be some overlap in arrivals and departures entering and exiting the city, which will also impact on car parking space supply.

For Saturday daytime events the Galleries car park is a viable choice for Arena visitors, which is not the case with evening events with a late finish. As such, this car park has been added to the possible supply of spaces for this scenario. It should be noted that these results exclude any consideration of on-street car parking supply in St Phillips, as no surveys have been were undertaken for a Saturday daytime period. However, it is considered that on-street car parking is likely to be available here during this period, which would only reduce the pressure on off-street car parks further.

Table 9.5: Saturday Daytime (Maximum Family Events)

Time Period	Existing Occupied Spaces P	Existing Occupied Spaces A	Arena Trips in Period	Cummul. Occupied Spaces P	Cummul. Occupied Spaces A	Car Park Occup. P	Car Park Occup. A
1200-1230	0	0	0	0	0	0%	0%
1230-1300	5197	5710	254	5705	6218	96%	93%
1300-1330	5258	5778	254	5639	6159	95%	93%
1330-1400	4963	5330	254	5598	5966	94%	90%
1400-1430	4594	4862	127	5738	6006	96%	90%
1430-1500	4530	4729	127	5801	6000	97%	90%

**Car park supply surveys started from 1230 onwards*

The results show that car parking demand in the over-lap period could just be met.

9.4.5 Saturday Evening: 12000 Event

Table 9.6: Weekday Evening (Maximum Capacity Event)

Time Period	Existing Occupied Spaces P	Existing Occupied Spaces A	Arena Trips in Period	Cummul. Occupied Spaces P	Cummul. Occupied Spaces A	Car Park Occup. P	Car Park Occup. A
1630-1700	3201	3528	776	3977	4304	80%	68%
1700-1730	3201	3526	776	4752	5077	95%	80%
1730-1800	2889	3211	724	5165	5487	103%	87%
1800-1830	2554	2873	724	5554	5873	111%	93%
1830-1900	2350	2667	357	5707	6025	114%	95%
1900-1930	2163	2479	357	5878	6194	118%	98%

The results show the full level of car parking demand associated with a 12000 capacity event on a Saturday evening could only be accommodated when taking into account on-street car parking availability and usage in St Phillips.

9.5 Disabled Parking

As with all Arena visitor trips, the number of disabled visitors in attendance at an event will vary in relation to the type of show, its scale and other UK venues also presenting this same offering. The provision of disabled parking in the proximity of the Arena is a product of the need to balance the conflicting

requirements of disabled persons, pedestrians, taxis, coach, drop-off, servicing and emergency vehicle access.

DfT guidance states that parking for Blue Badge holders should be accommodated as close as possible to the venue, and preferably within 50m. Given the constraints on the site, this has been a challenge, although 45 spaces will be provided on the Arena island site itself in close proximity to the venue building. This is considered to be good supply of disabled parking provision and similar to the level of disabled parking provided at other UK Arena sites of varying sizes. A comparison is provided below in **Table 9.7.**

Table 9.7: Disabled car parking provision at other UK Arenas

UK Arena venue	Capacity	Disabled parking bays
O2 Arena, London	20,000	113
SSE Hydro, Glasgow	13,000	96
Emirates Arena, Glasgow	6,500	26
First Direct Arena, Leeds	13,500	24 in Woodhouse Lane, further spaces in Merrion Centre
Phones 4u Arena, Manchester	21,000	58
Echo Arena, Liverpool	11,000	79
National Indoor Arena, Birmingham	14,000	Unknown
Odyssey Arena, Belfast	14,000	60. The Odyssey Car Park runs on a first come first served basis including disabled parking spaces.
Earls Court, London	19,000	Unknown
Capital FM Arena, Nottingham	10,000	20 spaces - There is a disabled car park right next to the National Ice Centre on Dean Street run by Nottingham City Council for blue badge holders on a first come first serve basis, as well as disabled spaces in all nearby car parks.
Manchester Central Arena	12,500	18
Derby Multi-Sports Arena	5000	28 Accessible spaces. 11 disabled spaces within 100m of the Arena entrance and 17 within 150m.
ExCel London	Capacity in the four separate halls will range from 6,000 to 10,000 visitors	A minimum of 4.7% of the total car parking spaces provided at the eastern and western car parks are wide bays with minimum dimensions of 3600 by 4800 mm. Thus there will be 158 bays suitable for disabled drivers on-site.

9.6 Overview

For a 'worst case' demand scenario with 80% of visitors assumed to travel by car into Bristol the results show that, for most events, there will be existing available parking supply in City Centre off-street car parks and/or on-street, close to Arena Island in St Phillips. This ignores the effect of any mitigation measures proposed to reduce City Centre car travel associated with the large events on a weekday and Saturday evening. The following are also factors to consider in considering the 'actual' demand and indeed available parking supply:

- UK Arena events rarely sell out and therefore it is a robust assumption to assume this level of attendance occurs for all large scale events. The arena operator predicts an average capacity large scale event attendance of 9,900 people, which is 2,100 people less than assumed in this chapter;

- The calculations take no account for the potential for third party land owners to offer private car parking sites in and around the City Centre, which will reduce demand for spaces in public car parks. Businesses in St Phillips with spare parking capacity in the evening is an obvious example;
- A number of car parks located within the city centre have been excluded from calculations due to their current opening times not being suitable for evening events. This applies to the Galleries car park. Once the Arena programme is established and the car park owners see the potential for parking revenue by staying open for two further hours, there is a real potential that car parking opening times for the Galleries may be amended to serve evening Arena events. However, for the purposes of the TA the Galleries has only been assumed to be an available choice for Saturday daytime events that coincide with its current opening hours; and
- There are other off-street public car parks outside the identified 20 minute walk zone with suitable opening times and, whilst not included in the assessment of available supply, these may also be used by visitors.

SECTION 10

Arena Mitigation - Non Event Specific

10.1 General

This chapter of the TA sets out the additional transport improvements or mitigation measures which would be put in place to build on the various committed schemes proposed to improve accessibility to and around the Arena Island, or necessary to guard against adverse impacts associated with any event. This includes measures to facilitate safe and convenient drop-off/pick-up for coaches and taxis, and measures necessary to prevent visitors using adjacent residential streets for on-street parking.

10.2 On-Street Parking Controls

10.2.1 Totterdown/Upper Knowle/Windmill Hill/The Dings

Figure 10.1 shows the existing Residents Parking Schemes either in place or 'to be implemented' in the zone of influence of the Arena, and more particularly the 20 minute walk zone around it. It is considered that visitor parking on street in Totterdown/Upper Knowle/Windmill Hill/The Dings is highly likely as no present controls exist. It would be an unacceptable nuisance risk without intervention. As such the Arena developer would cover the cost of implementing parking controls in these areas prior to the Arena opening, or after (up to a period of 5 years). This will cover the cost of surveys, consultation, scheme design and sign fabrication/implementation. It is considered that parking management would be developed and agreed with residents. An appropriate sum will be agreed with the highway authority.

10.2.2 Existing Residents Parking Zones

As shown on Figure 10.1, a number of existing RPSs fall within the 20 minute walking distance extent around the Arena site. As such, the Arena developer will cover the costs necessary to extend the operating hours in the existing adjacent RPS covering Easton/St Phillips, Redcliffe and Bedminster East, as required. These currently operate from 9:00am-5:00pm Monday to Friday, and it is considered these weekday times may need to be extended to 7:00pm, and Saturday restrictions included.

Again, changes to the existing scheme would be developed in consultation with residents in these existing zones, prior to any decision to proceed.

10.3 A4 Bath Road: Pedestrian/Cyclist Improvements

10.3.1 Need for Improvement

As discussed earlier in the Transport Assessment the existing footway along the east side of the A4 Bath Road between the A4/A37 Three Lamps junction and Bath Bridge is narrow. The importance of achieving a high quality pedestrian/cyclist linkage between Arena Island and the residential areas of the city to the south of Three Lamps is recognised. This is not only necessary to cater for higher crowd loadings expected during the larger Arena events, but to promote and improve everyday accessibility to both Arena island and the wider TQEZ from the south.

10.3.2 Expected Visitor Footfall

Event generated pedestrian flows from the south via the A4/A37 Three Lamps junction would have potentially the greatest conflict in the weekday evening period. This is because this demand would be directionally opposite to the tidally dominant outbound or southbound flow of pedestrians and cyclists

returning from work in the 5:00-7:00pm period. The existing volumes of pedestrians using this narrow footway/cycle lane between 4:00-7:00pm on a weekday was described earlier in the TA. To estimate the likely pedestrian flows using different routes to Arena Island the 'worst case' mode split has been applied. Where people walk from, and using which route, will be dominated to an extent by where people choose to, or are able to park. This is because 'car occupant' is expected to account for 80% of visitors to an evening event on a weekday or Saturday evening under a 'worst case' scenario. The pedestrian routes used by visitors arriving by rail is obviously dictated by the location of Temple Meads to the north of Arena Island, whilst the location of the coach drop-off/pick-up, taxi stands, and main bus stops will define the access pedestrian routes used by visitors using these modes.

Adopting the above principles suggests the following access route distribution and demands for a 12,000 maximum capacity event:

- Most visitors arriving by car will be expected to park in central area car parks or in the St Phillips area. The latter will have on-street space capacity for about 500 cars on a weekday and Saturday early evening (based on surveys done), so this would create a 'car occupant' pedestrian demand of around 1,200 over the 4:30-7:30pm period from the east;
- Parking in most of the identified off-street car parks will generally lead to pedestrian desire line routes via Temple Way or Redcliffe Way, so most visitors will use either the Temple Greenway route or Cattle Market Road to get to the HCA Bridge. As noted earlier, it is envisaged controls will be in place to deter visitor parking in Totterdown/Windmill Hill/The Dings and the currently to be implemented Bedminster East RPS. This will help to reduce pedestrian flows on the A4 Bath Road from Three Lamps, notwithstanding the benefits in reducing nuisance parking. Use of either Temple Greenway, Cattle Market Road, or potentially Avon Street would be the routes most likely used by this residual car occupant pedestrian demand (8,100);
- Rail visitors would most likely access the Arena via Cattle Market Road (480). Also, most bus services stop in either Temple Gate, Redcliffe Way or Temple Way, so most of these visitors will access the Arena on foot from the north and west (600);
- As will be described later in this Chapter, coach drop-off/pick-up will occur in Victoria Road/Albert Road, so these visitors will arrive on foot via the Feeder Road/Albert Road junction or the new footbridge link to Albert Road (240); and
- The residual 'walk/cycle' trips could arrive from any direction, but if it was assumed the bulk arrived from the Totterdown/Knowle/Windmill Hill residential areas then the maximum predicted pedestrian flows from/to Three Lamps could be 840 (7%). The arrival flow could be spread over a three hour period, but for these local access trips may be more concentrated in the 6:00:7:00pm period. Information from the operator suggests that the typical proportion of 'at venue' arrivals in the hour before the performance starts is 70%. All departures would be concentrated in the period just after event close, with most expected to leave in the hour following the end of an evening show.

It is accepted that some of the local 'walk' demand could come from other residential areas within the local Arena catchment, such as Redcliffe or the Dings. However, the main residential areas within a convenient walking distance of Arena Island lie to the south and west of Three Lamps, with a high proportion of these visitors thus likely to walk in from this direction.

10.3.3 'On-Line' Mitigation Options Considered

10.3.3.1 Removal of the Western Footway

Taking out the footway on the western side of the A4 to achieve widening of the eastern footway isn't an option. Adopting a minimum clearance of 450mm on this side and moving the running carriageway

over would make side road visibility achievable from the existing access to/from Arena Island virtually nil. It also assumes that this could be done easily over the main rail bridge structure, where there are likely to be service conduits under the footway. It is also noted that, at the second bridge over the spur line, the carriageway already runs adjacent to the west edge of the structure with no footway, with footway continuation achieved with a separate footbridge structure on the west side of the road bridge. The key point is that an improvement in the width of the eastern footway over this bridge could therefore only be achieved by sacrificing one of the carriageway running lanes.

10.3.3.2 Remove the Existing 'On Footway' Cycle Lane or Re-Route

Moving the segregated cycle facility onto the western footway to create more pedestrian clear-width on the east side is less than ideal as the width here looks even more unsuitable. Part of the displaced route would also involve deviation through the aforementioned narrow footbridge. However, a key issue is the fact that, from observations, most cyclists using the existing segregated path are travelling outbound from the City Centre so this is the logical place for it to be (linking the access point at Cattle Market Road with Three Lamps without a need for cyclists to cross-over the A4 Bath Road). Crossing the facility over to the west footway would create a very inconvenient route for cyclists, particularly those continuing outbound on the A4.

Inbound cyclists have the opportunity to use the bus lanes present on both the A4 and A37 approaches to Three Lamps, and the bus lane between Three Lamps and Bath Bridge Roundabout beyond this, which is probably why most of the cyclists observed using the segregated eastern footway are travelling south or outbound.

Simply increasing the pedestrian space on the east footway by removing the cycle lane and forcing cyclists to cycle in the nearside outside lane 'on carriageway' would be very difficult to promote. This is something that exists now and, whilst technically a substandard shared use arrangement, is perceived to be safer. The surveys also show that this existing 'on footway' lane is extremely well used by cyclists, so removing this facility would result in additional hazard to a large number of vulnerable road users. Furthermore, alternative routes via either St Lukes Road or Totterdown Bridge would represent quite a diversion.

10.3.3.3 Removal of the Inbound Bus Lane

Widening the footway on the eastern side of the A4 Bath Road between Bath Bridges and Three Lamps could be achieved by taking out the inbound 24hr bus lane. However, discussion with BCC transport officers has indicated that this would not be supported on any grounds, and most likely strongly objected to by the bus operator. Notwithstanding this, it also creates a number of other issues as follows:

- The inbound carriageway would be restricted to only one running lane between the Three Lamps junction and the approach to Bath Bridges. As such, any vehicle breakdown could create a significant impedance issue, especially if queuing traffic is present in the outside of the two southbound lanes towards Three Lamps, which is often the case. With the current arrangement, northbound drivers can pass a broken down vehicle by entering the bus lane if necessary;
- At the Three Lamps junction the inbound A4 Bath Road approach allows a bus and other traffic to proceed concurrently when the signal is green. Restricting the inbound, northbound exit to one lane would require split-signalling of these movements, as they could not be permitted to proceed concurrently on a green signal as now. This would involve installing a 'splitter' island between the two lanes in the vicinity of the stop-line, which would be very difficult. A more likely solution would be the need to terminate the bus lane further back with a pre-signal to assist egress, so another retrograde step in terms of the bus priority available on the A4 route; and

- On the A37 Wells Road approach bus lane users are expected to yield when required at the junction. However, observations show buses and other permitted bus lane users often continue without stopping when the adjacent A37 signalled lane has a green signal and right of way. With the exit restricted to one lane the bus lane termination on the A37 Wells Road entry would need to be positively controlled for road safety reasons. A requirement for a separately signalled bus phase would also impact upon and reduce junction capacity.

10.3.3.4 Reduce the Length of the Outbound Right Turn Lane to the A37

This would create significant operational implications as the queuing in this lane often extends close to Bath Bridge Roundabout in the weekday PM peak period, and also at other times. Shortening the right turn lane to the A37 Wells Road would significantly increase the risk of this queuing extending beyond it, thus blocking and impeding the outbound straight-ahead movement along the A4 Bath Road. This would have widespread 'knock-on' congestion impacts affecting Bath Bridges Roundabout and the Temple Circus area.

10.3.3.5 Use Temporary Traffic Management during Events

Using TTM and installing barriers to take out the nearside lane on Bath Road to create pedestrian space for dealing with late evening event departures is not a solution, as whatever mitigation is put in place needs to cater for people arriving for events in the 5:00-7:00pm period, not just departure times. It would also fail to cater for arrivals or departures associated with all Saturday matinee events. For highway operational reasons it is unlikely any removal of this lane could be contemplated before 9:00-10:00pm on a weekday or Saturday.

10.3.3.6 Conclusion

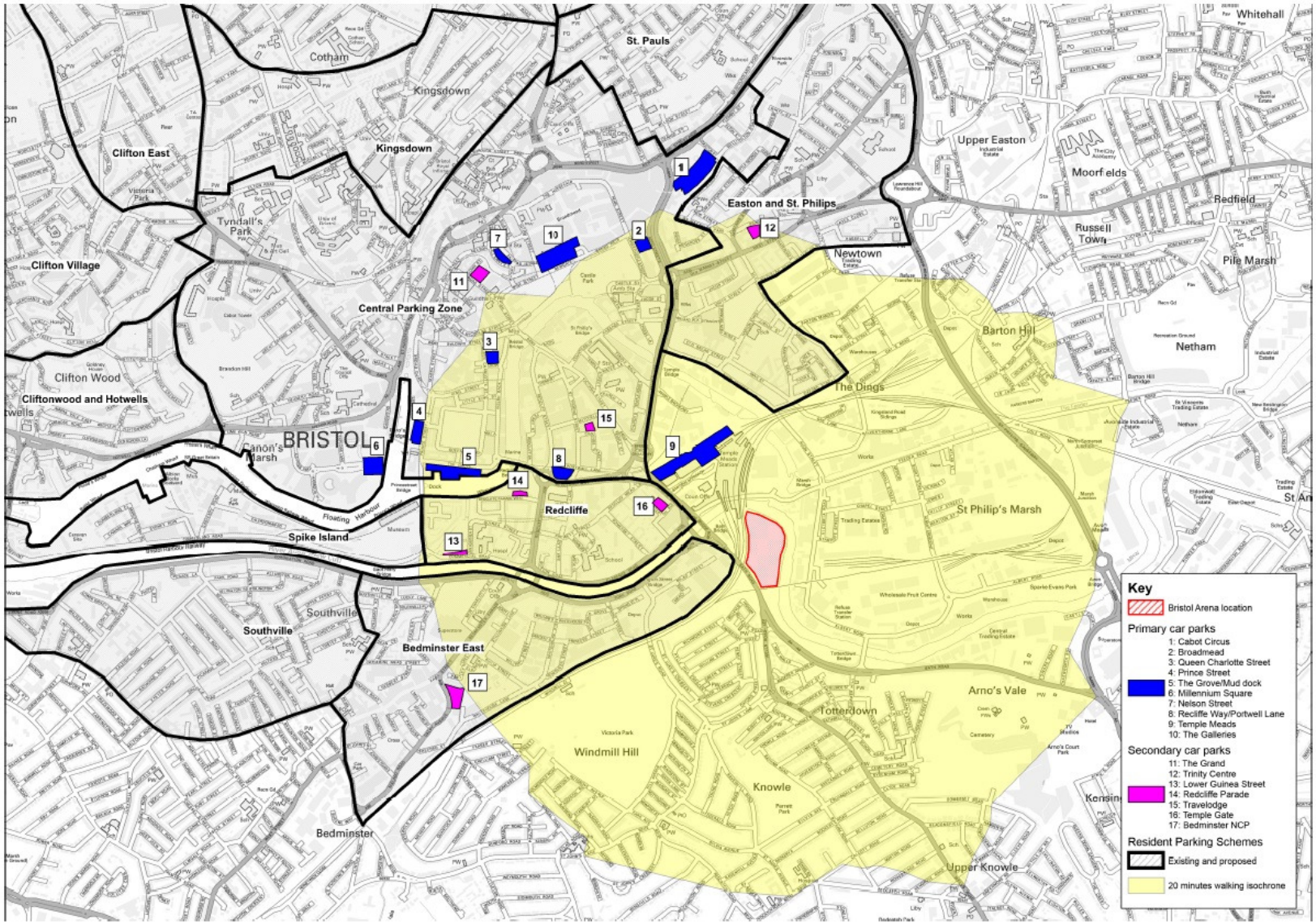
After considering all these 'on line' options it was concluded that none would allow an improvement to be made to the pedestrian space on the east footway without unacceptable impacts to either cyclists, buses or highway operation. In view of this an off-line linkage was developed as described in the following section.

10.3.4 Proposed Changes

Drawings showing the proposed works to improve pedestrian/cyclist access between Arena Island and the A4/A37 Three Lamps junctions are included in **Appendix I**. The proposals include a new pedestrian/cycle bridge over the railway spur adjacent to the existing road bridge, with the northern end of this linking direct to the proposed Arena terrace.

On the south side of the new bridge the existing footway between the landing point and the Three Lamps junction would be widened as shown on the drawings to provide, in effect, a southern 'gateway' to Arena Island and beyond. This will involve some cut-back into the vegetation and rock-face on the east side, and changes to the interface with the existing footpath link to Albert Road via the railway bridge. It is noted that the latter was a potential route which might have been used by some visitors to access Arena Island from this direction. However, this is unsuitable by virtue of the tortuous route involved, it's gradient and stepped sections.

Figure 10.1: Existing Residents Parking Schemes and the Arena Island 20 minute walk zone limit



10.4 Coach Drop-Off/Pick Up

10.4.1 Proposed Zone

The proposed area for accommodating drop-off and pick-up for coaches is the northern end of Albert Road, or more particularly Victoria Road, which runs parallel to it between the junction with Feeder Road and Stanhope Street.

Highway works and associated permanent TRO's necessary to create a 9nr bay coach drop-off/pick up zone in the Albert Road/Victoria Road area are shown in Drawing Nos. 203742.DC.00.83- 07/08 in **Appendix J**. This includes footway widening works along the east side of Victoria Road, and an allied one-way TRO making Victoria Road southbound only. Consideration was given to accommodating coach drop-off/pick up on the west side of Victoria Road with this street made one-way in the northbound direction instead. However, the land on the island formed by Albert Road, Victoria Road and Stanhope Street is currently in use as a number of small private car parks linked to businesses close by, with all the accesses from these car parks onto Victoria Road. This makes the creation of coach stands on this side impractical because of the need to maintain clearance for all these accesses, and visibility for emerging vehicles.

The proposed arrangements will allow for set-down and pick-up of passengers only, with the latter the more critical period. Whilst set-down is generally a relatively quick operation, pick-up will require a typical wait time of 20-30 minutes 'on stand' to allow for delays in passengers getting back to their coach at the pre-arranged time. As such, the proposals create a 'pick-up' capacity for up to 18 coaches per hour.

Where the expected volume is low, it may be possible to permit coaches to lay-over/park in this zone during the event. Where this is not possible coach drivers will need to park remotely using existing coach parking facilities available within the city centre. Currently, these are:

- The coach park in front of Cabot Circus car park; and
- Cumberland Road.

The possibility of using other facilities is also under investigation.

10.4.2 Ancillary Highway Works

In addition to the footway widening in Victoria Road, improvements to the Albert Road/Feeder Road junction to add a controlled crossing facility on the Albert Road arm of the signals are also proposed. This is currently an uncontrolled crossing point but with a wide central refuge. Adding signalled crossing control will facilitate safer pedestrian movement between the coach drop-off/pick up area and the eastern end of Cattle Market Road. The latter will be access limited for vehicles between the HCA Bridge and this junction during events through marshalling.

10.4.3 Additional Temporary Traffic Management - Large Evening Events

During evening events on a weekday and Saturday it would be proposed to close the section of Albert Road between Stanhope Street and Feeder Road to general traffic between 6:00pm and midnight using a Traffic Regulation Order (TRO). Only coaches and vehicles requiring essential access to commercial/ industrial properties within the closed area will be permitted to enter. The objective of doing this is to reduce conflict between coaches, pedestrians and drivers seeking on-street parking or looking to set-down passengers in this zone prior to and after events taking place at this time. The 'through' closure of Albert Road will require additional temporary signing at the Albert Road/Totterdown Bridge junction to advise drivers, although any drivers routing northbound on Albert Road in error, or to look for parking, will be able to access Feeder Road via Stanhope Street/Chapel Street/Short Street.

It is not proposed to effect this closure during matinee events on a Saturday which, as previously stated, could be in the morning, mid-afternoon or early evening. This would have a potentially greater impact on businesses in this area, some of which will be open during the day on Saturdays. However, a closure brought into effect as required at 6:00pm on a weekday/Saturday will have limited impact on these businesses. As noted previously the Saturday matinee events will also be smaller than the large evening events, with expected maximum and average sized attendance of 6,000 and 4,000 people respectively. As such, the numbers of coaches expected with Saturday matinee events will be lower, accepting that certain types of events appealing to a specific cross-section of the population may create higher coach demands on occasion.

10.5 Taxi Drop-Off/Pick Up

10.5.1 Saturday Matinee Events

During Saturday matinee events it is proposed that visitors would be directed to existing ranks on Station Approach, where there is likely to be adequate existing provision at this time. Facilities here are well established, and this area already used as a known 'taxi hub' by users of this part of the city centre aside from rail travellers.

10.5.2 Late Night Evening Events

During weekday and Saturday evening events with a late finish the availability of taxis using Station Approach for pick-up is less guaranteed. As such, with the TRO in place affecting the closure of Albert Road between Feeder Road and Stanhope Street, a bespoke temporary waiting area for taxis would be provided on the Feeder Road approach to the Albert Road junction utilising the redundant left/ahead lane.

It is proposed that waiting capacity for taxis at this time should include the short length of proposed limited waiting parking in front of the rank of shops just upstream of the junction (Mon-Sat 8am-6pm, 1hr limit). The timing of the TRO closure coming into effect at 6:00pm will coincide with the expiry of the limited waiting restriction here. It is thus proposed that this limited waiting parking area would be reserved as a taxi rank between 6:00pm-midnight using a permanent TRO, and a rank with the same operating times created between the western edge of this area and a point some 10m from the stop-line at the Feeder Road/Albert Road junction.

10.6 Public Drop-Off/Pick Up

Experience from the Leeds Arena suggests that making active provision for public drop-off/pick-up close to the site should ideally be planned and provided for, although this was not done there leading to indiscriminate drop-off/pick-up on roads around. However, the opportunities for a bespoke drop-off/pick-up zone close to Arena Island are very constrained, because of the nature of the surrounding road network and the temporary closures which it is proposed to put in place for large events affecting both Cattle Market Road and the northern end of Albert Road. The optimal location(s) for accommodating this will need to be further investigated as part of the on-going Travel Plan to ensure that appropriate sites are identified to serve a range of approach directions. There is also likely to be the need to review the effectiveness of identified sites following Arena opening to ensure they remain appropriate and are operating effectively. This will inform the advice which is to be given to visitors via the Arena web-site and other media. The following potential options have so far been identified:

- An advisory drop-off/pick-up area located in Albert Road, to the south of Stanhope Street and close to the proposed St Phillips bridge link to Arena Island;
- Possible use of Avon Street, although width and opportunity here is much more constrained; or

- Possible use of part of the former PO depot site now in BCC ownership on a temporary basis pending the redevelopment of this site, and potentially longer term as part of the Master-planning.

10.7 Signing/Way Finding

An agreed financial contribution would be made to the cost of new and/or revised way finding signing to the Arena Island, principally from the City Centre and central car parks. The Temple Greenway and Temple Circus schemes will include new signing provision as part of the works specification for these transport improvements. As such, it is assumed that appropriate destination wording can be added to new signing prior to installation.

10.8 Soft Measures - Transport/Parking Information

A specific section advising on travel options to the Arena will be developed and maintained as part of the Arena web-site. This will include a link to a digital platform in the process of being developed by the City Council, which will provide real time information on parking capacity available in the main central area car parks. The web-site will also provide information on additional transport measures being put in place for specific events, although it is proposed that this supplementary information would also be issued with tickets. This event specific mitigation is discussed later in the Transport Assessment.

As happens now, existing VMS signs on specific approaches to the City Centre will continue to provide driver information on spaces available in central car parks; it is not intended that specific additional messaging will be displayed for Arena users to, for example, advise on the use of specific car parks. No additional VMS provision is proposed to direct drivers to the St Phillips area via the Bristol Spine Road, from M32 Junction 3 and the A4 Bath Road. This is because, whilst a significant quantum of on-street parking is likely to be available to visitors attending events as noted in Chapter 3, no bespoke off-street parking for the Arena is proposed in this area.

10.9 Other Highway Works Considered

10.9.1 Three Lamps Junction

The need created by the Arena for an improvement to the A4/A37 Three Lamps junction to introduce a right turn from the A37 Wells Road to the A4 Bath Road has been suggested and investigated. At present, drivers who want to execute this manoeuvre must continue northwards to Bath Bridge roundabout and make a 'U' turn.

A full turning count was undertaken at Bath Bridges Roundabout on Thursday 27th June 2013 as part of the GBATs model update. This shows that the 'U' turn associated with the A4 Bath Road arm was only 140 vehicles between 7:00am and 7:00pm, so as expected this is not a very significant movement at the moment. Part of the reason for this is that many drivers use Talbot Road in Knowle as a 'cut through' between the A37 and the A4, permitting access to be obtained to the St Phillips area via St Phillips Causeway and Albert Road. The same route is used to access the outbound A4 Bath Road, with drivers doing it able to avoid the A4174/ A37 junction and the A4174 Callington Road. It is thus a well-known existing 'rat-running' issue.

Figure 8.2 presented earlier in this Transport Assessment showed that the expected proportion of car borne visitors expected to arrive via the A37 is circa 7.6%. So looking at a 12,000 maximum capacity event on a weekday this would equate to about 270 vehicles over a three hour arrival profile period from 16:30-19:30pm. Looking at the worst hour the volume would be about 100 vehicles (40%). The justification for making quite significant changes to the Three Lamps junction to accommodate this level of flow perhaps 20 times a year, thus needs to be balanced against what regular capacity reducing

impact it might have on operation in every peak hour. Examination of the potential to change the existing layout has revealed the following issues:

- Accommodating the turn at the existing traffic signals would make it very difficult to run the A37 Wells Road inbound lane and the right turn (to A37) from the A4 Bath Road concurrently as now. It would also create a vehicle conflict with the outbound straight-ahead lane on the A4, which at present is only held on red by a call for the pedestrian/cycle crossing. The first issue is a real showstopper in highway capacity terms and would massively impact on normal junction operation;
- The only way a separate right turn lane might be created on the A37 Wells Road approach to the signals would be to the remove the length of bus lane between Bellevue Road and the junction, so allowing straight-ahead vehicles to use this but breaking the continuity of the existing bus priority. Even if this were considered acceptable, there would still be significant alterations necessary to accommodate this right turn to the A4 outbound exit, whilst an additional stage in the existing two stage traffic signal Method Of Control would still be needed to service it; and
- The only sensible means of achieving this linkage would be by providing a right turn link slightly further back, where the left turn link from the A4-A37 provides the opposite connection now. However this would require a second set of signals on the A4 Bath Road around 20m from the existing to safely accommodate the movement of right turning vehicles across the Bath Road. The following are also key issues:
    - At the A37 Wells Road end of the link it will be difficult in space terms to accommodate any waiting right turners turning across opposing traffic into the link. Storage capacity possible within the link itself for holding vehicles when the signal is red will be limited so, if well used, there is a high probability that waiting right turners will queue back onto Wells Road and block straight-ahead traffic. A likely consequence is that impeded straight-ahead drivers will try to pass any obstruction created by bypassing it using the bus lane; and
    - A link here could open up the risk of drivers routing via Bellevue Road through Upper Totterdown to get access to it. At the present time egress from Bellevue Road is left turn only, but works to facilitate the link would require removal of the existing central island on the A37 in this locality. A left turn only TRO could be left in place, but unlike now, could not be physically enforced to ensure compliance; and
    - The level of daily traffic demand that might be attracted to use such a linkage if created from St Johns Lane, potentially Bellevue Road or from further south on the A37 is unknown. As noted earlier, a regular queue of right turning vehicles extending back onto the Wells Road will serve to disrupt and impede the inbound straight-ahead traffic on the A37, and potentially bus services on this route.

In view of the above it is not considered that the expected traffic impact on the A37 with even the biggest events merits works at Three Lamps as ‘necessary’ transport mitigation associated with the Arena. The creation of the link could also have some unforeseen or undesirable impacts affecting the operation of both the A37 and A4 in this locality in the weekday peak periods and other times, notwithstanding the benefit it might have in drawing traffic away from Talbot Road.

Traffic Impact & Forecast Modelling - 'Worst Case'

11.1 Introduction

This chapter presents a worst-case in terms of Arena traffic impacts, based on the car occupant mode splits set out in Chapter 8. These results are based on robust trip generation parameters but, at this stage, take no account of specific mitigation measures which may be needed for specific events. Traffic signal timings and co-ordination also retains fixed base model settings, so providing a robust assessment of traffic impact.

11.2 Scenarios Tested

The following five scenarios have been modelled using both the GBATS SATURN model of the Bristol area, and the detailed S-Paramics model of the city centre road network close to the Arena site:

- 2021 Weekday evening (3:00-8:00pm): 6,000 event;
- 2021 Weekday evening (3:00-8:00pm): 12,000 maximum capacity event;
- 2021 Saturday evening (4:00-7:00pm): 6,000 event;
- 2021 Saturday evening (4:00-7:00pm): 12,000 maximum capacity event; and
- 2021 Saturday daytime events (12:00-3:00pm): 2nr 6,000 events at 11:00am and 3:00pm with departures/arrivals over-lapping in the 12:00-3:00pm period.

11.3 Arena Matrices

The traffic generation, distribution and destination car parking assumptions set out in the above chapters were input into the GBATS model as specific origin-destination demands. Since GBATS models only a single hour, only the percentage of Arena traffic was modelled. This typically reflected the busiest single hour in terms of Arena traffic with the volume based on a proportion of the overall number of arrivals as assumed in the profiles set out in Chapter 8.

The GBATS model was then run and a cordoned 'delta' matrix was produced for the S-Paramics model area. Separate runs were carried out for Arena visitor arrivals, visitor departures, and staff arrivals, as appropriate to the scenario modelled. For each scenario, and in the absence of a Saturday model, these were carried out using the weekday evening peak hour (5:00-6:00pm) GBATS model.

The delta matrices extracted from GBATS for each Arena scenario contained a series of origin-destination pluses and minuses. These were separated using a spreadsheet, with the pluses extracted to create the various Arena trip type (visitor arrival, staff arrival etc.) matrices. These pluses were then factored up to reflect the full number of Arena trips entering the S-Paramics model area over the wider periods considered.

Minuses seen in the delta matrices were due to existing or background traffic displacement effects caused by Arena trips. These were summed and applied to the origin/row totals within the background light and heavy vehicle matrices as pro-rata reductions. This was to ensure that the full displacement effects predicted by GBATS were taken into account. These predicted GBATS reductions in existing trips for a single hour were similarly factored up to reflect expected diversionary effects over the longer periods considered in the S-Paramics models.

Early simulations of the weekday evening Arena scenarios highlighted that the displacement prevented the typical build-up of congestion in the model. This was because the displacement was, in effect, occurring prior to the arrival of Arena trips in the network resulting in lower volumes of network traffic in the model warm-up period. As this would be unlikely to happen in reality, the background profiles were adjusted with an up-lift applied prior to 4:30pm and rebalanced to reduce in-flows once Arena traffic was entering the model.

The result matrix totals for each for the above modelled scenarios are shown in Table 11.1. These are the sum of all matrix levels within each scenario. For comparison, the associated 2021 Reference Case matrix totals are also shown.

Table 11.1: S-Paramics Traffic Model Matrix Totals

Time Period	Reference Case	6,000 Event (including Matinee)	12,000 Event
2021 Weekday Evening (3:00-8:00pm)	58,976	59,872	60,779
2021 Saturday Evening (4:00-7:00pm)	31,999	32,881	33,738
2021 Saturday Afternoon (12:00-3:00pm)	35,926	36,592	-

11.4 Model Outputs - Weekday Evening

This section provides a summary of the model outputs from S-Paramics for the 2021 weekday evening (3:00-8:00pm) 6,000 and 12,000 capacity event scenarios. The outputs represent an average from 20 separate random seed runs. Checks on the variance in mean network delay from these runs confirms that 20 runs are sufficient to provide robust results. More detailed modelling outputs are presented in **Appendix K.**

11.4.1 Network Performance

Table 11.2 compares the network performance outputs from S-Paramics for all scenarios modelled during the weekday evening period (3:00-8:00pm), including, for completeness, the 2013 base year model output.

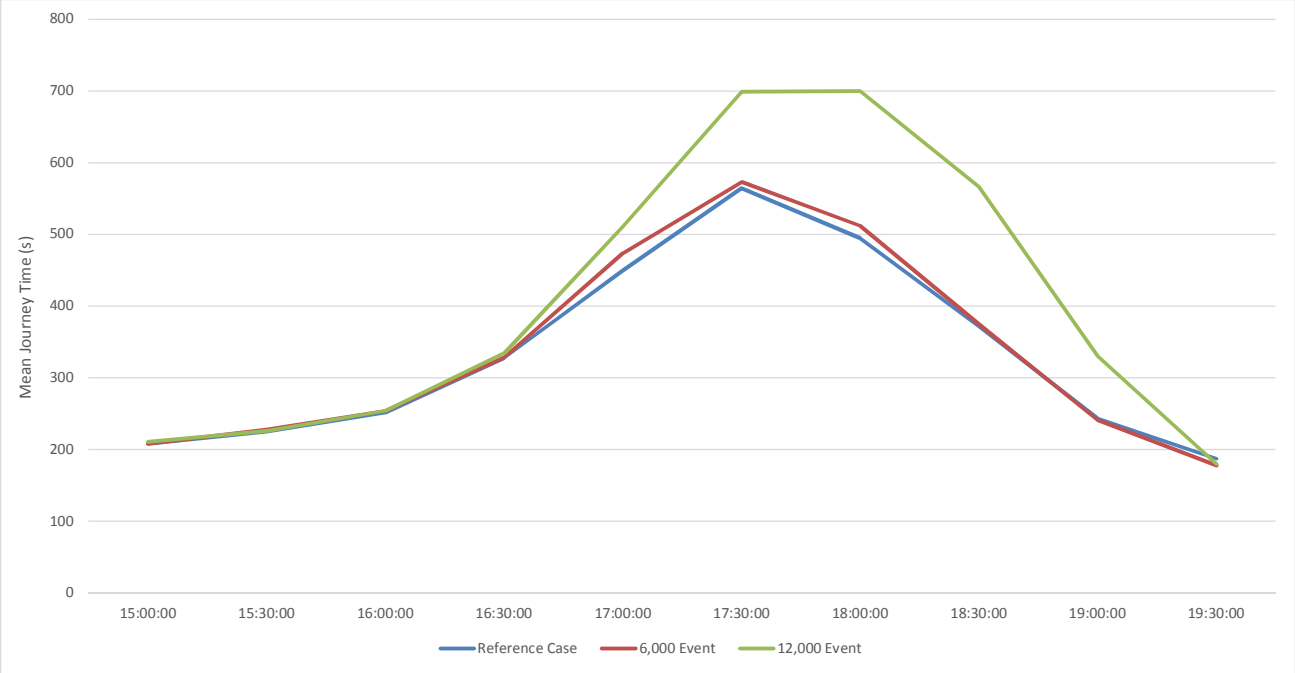
Table 11.2: Network Performance Statistics, Weekday Evening (3:00-8:00pm)

Network Variable	2013 Base	Reference Case	6,000 Event	12,000 Event
Mean delay (s)	305	385	408	525
Total distance (km)	119,306	123,141	124,683	125,717
Vehs Entering Network	57,934	59,314	60,310	61,208
No. Vehs at 7:59pm	602	668	635	756
Journeys Completed	57,332	58,646	59,676	60,452
Network Demand	57,395	58,946	59,872	60,779
% Demand Satisfied	98.77%	98.31%	98.52%	98.33%
Mean Speed (mph)	15	12	11	9

The results indicate a slight deterioration in network conditions between the 2021 Reference Case and 6,000 event scenarios, although this is not significant. However, the larger 12,000 maximum capacity event results in a notable increase in network delay of 140 seconds compared to the Reference Case together with a drop in mean network speeds by 3mph.

Figure 11.1 compares the profile of network-wide mean journey times through the S-Paramics model network throughout the modelled period. The graphs confirms that the traffic associated with the 6,000 event does not have any significant impact on aggregate network journey times compared to the Reference Case. For the 12,000 capacity event there is a notable increase in peak hour (5:00-6:00pm) journey times, as well an extension of the peak beyond 6:00pm.

Figure 11.1: Network-Wide Mean Journey Times, Weekday Evening (3:00-8:00pm)



11.4.2 Traffic Flows

Table 11.3 shows the modelled traffic flows on the major routes entering the S-Paramics model area for the 2021 Reference Case, and the results change arising from the inclusion of a 6,000 event. The results highlight that the largest increases occur on the M32, Old Market Street, Wells Road and Bedminster Parade, with most traffic entering the network between 6:00 and 7:00pm. The table also shows a number of reductions on some routes arising from the localised Arena traffic displacing other movement through the model area.

Table 11.3: Modelled Traffic Flow into Network, 6,000 Event, Weekday Evening (4:00-8:00pm)

Route	**Reference Case**				**6,000 Event (Traffic Change)**			
	4-5pm	5-6pm	6-7pm	7-8pm	4-5pm	5-6pm	6-7pm	7-8pm
M32 Newfoundland Street	1807	1939	1626	1129	80	164	172	93
Houlton Street	91	96	80	64	11	8	28	18
A420 Old Market Street	1249	1336	977	639	30	-47	68	33
A4 Bath Road	555	585	432	474	2	8	15	-6

Table 11.3: Modelled Traffic Flow into Network, 6,000 Event, Weekday Evening (4:00-8:00pm)

Route	**Reference Case**				**6,000 Event (Traffic Change)**			
A37 Wells Road	663	694	523	561	21	-17	45	5
St John's Lane	306	324	230	276	12	11	16	7
St Lukes Road	347	338	267	202	14	13	8	3
A38 Bedminster Parade	583	555	540	343	31	41	5	3
A370 Coronation Road	751	705	681	509	-30	-5	-23	-24
Commercial Road	823	783	664	496	-10	-12	-8	-10
Redcliffe Bridge	324	311	254	201	25	23	3	19
Victoria Street	783	741	638	525	0	10	-1	-11
Lower Castle Street	580	538	493	348	-5	-32	17	-10
A4044 Bond Street	2543	2520	2304	1389	31	-19	-4	1
TOTAL ENTERING	**11405**	**11465**	**9708**	**7154**	**212**	**148**	**343**	**119**

Table 11.4 provides the same comparison in traffic entering the S-Paramics model area by hour for a 12,000 maximum capacity event. The results show a similar pattern of increases to a 6,000 event, although these are much greater in magnitude. The traffic flows are also lower on a number of routes during the 5:00-6:00pm peak hour suggesting a higher degree of congestion preventing traffic from entering the network. The hourly totals show that this traffic eventually enters during the latter two hours of the simulation with the majority of vehicles entering between 7:00 and 8:00pm.

Table 11.4: Modelled Traffic Flow into Network, 12,000 MAX Event, Weekday Evening (4:00-8:00pm)

Route	**Reference Case**				**12,000 MAX Event (Traffic Change)**			
	4-5pm	5-6pm	6-7pm	7-8pm	4-5pm	5-6pm	6-7pm	7-8pm
M32 Newfoundland Street	1807	1939	1626	1129	117	216	444	271
Houlton Street	91	96	80	64	13	9	28	43
A420 Old Market Street	1249	1336	977	639	45	-44	74	62
A4 Bath Road	555	585	432	474	1	-1	3	-12
A37 Wells Road	663	694	523	561	25	-41	95	5
St John's Lane	306	324	230	276	24	34	43	20
St Lukes Road	347	338	267	202	11	7	17	0
A38 Bedminster Parade	583	555	540	343	59	82	49	32
A370 Coronation Road	751	705	681	509	-61	-55	-76	3
Commercial Road	823	783	664	496	-4	-16	-9	4
Redcliffe Bridge	324	311	254	201	13	-38	-38	77
Victoria Street	783	741	638	525	8	-15	4	-2

Table 11.4: Modelled Traffic Flow into Network, 12,000 MAX Event, Weekday Evening (4:00-8:00pm)

Route	Reference Case				12,000 MAX Event (Traffic Change)			
Lower Castle Street	580	538	493	348	3	-89	19	68
A4044 Bond Street	2543	2520	2304	1389	1	-222	-206	514
TOTAL ENTERING	**11405**	**11465**	**9708**	**7154**	**256**	**-175**	**446**	**1085**

The traffic flow results presented above suggests that some traffic was unable to enter the model during the busiest period. Table 11.5 compares traffic held outside of the model at 6:00pm, 7:00pm and 8:00pm for the 2021 Reference Case and 6,000 event scenarios.

Table 11.5: Unreleased Traffic Analysis, 6,000 Event, Weekday Evening (6:00-8:00pm)

Route	Reference Case			6,000 Event		
	@ 6:00pm	@ 7:00pm	@ 8:00pm	@ 6:00pm	@ 7:00pm	@ 8:00pm
M32 Newfoundland Street	0	0	0	0	0	0
Houlton Street	0	0	0	4	0	0
A420 Old Market Street	42	0	0	102	0	0
A4 Bath Road	0	0	0	0	0	0
A37 Wells Road	3	0	0	18	0	0
St John's Lane	0	0	0	0	0	0
St Lukes Road	1	0	0	0	0	0
A38 Bedminster Parade	0	0	0	0	0	0
A370 Coronation Road	5	15	0	0	19	0
Commercial Road	0	0	0	0	0	0
Redcliffe Bridge	5	0	0	8	1	0
Victoria Street	5	1	0	6	0	0
Lower Castle Street	22	0	0	41	0	0
A4044 Bond Street	0	1	0	6	1	0

The results in Table 11.5 show that there is an increase in traffic queued outside of the model network during the 5:00-6:00pm peak hour on Old Market Street and Lower Castle Street. However, these increases are not significant and clear by 7:00pm.

Table 11.6 provides the same analysis of unreleased traffic for a weekday evening 12,000 maximum capacity Arena event. The results highlight more notable increases in edge congestion during the 5:00-6:00pm peak hour, particularly on Bond Street, with traffic queues outside of the network persisting between 6:00 and 7:00pm. Collectively, this suggests a highly congested network with conditions only easing by around 7:00pm with this largest event occurring.

Table 11.6: Unreleased Traffic Analysis, 12,000 MAX Event, Weekday Evening (6:00-8:00pm)

Route	**2021 Reference Case**			**12,000 MAX Capacity Event**		
	@ 6:00pm	@ 7:00pm	@ 8:00pm	@ 6:00pm	@ 7:00pm	@ 8:00pm
M32 Newfoundland Street	0	0	0	0	0	0
Houlton Street	0	0	0	30	8	7
A420 Old Market Street	42	0	0	112	0	0
A4 Bath Road	0	0	0	0	0	0
A37 Wells Road	3	0	0	44	0	2
St John's Lane	0	0	0	0	0	0
St Lukes Road	1	0	0	0	0	1
A38 Bedminster Parade	0	0	0	0	0	0
A370 Coronation Road	5	15	0	11	39	0
Commercial Road	0	0	0	0	7	0
Redcliffe Bridge	5	0	0	41	24	0
Victoria Street	5	1	0	21	0	0
Lower Castle Street	22	0	0	101	0	0
A4044 Bond Street	0	1	0	216	197	0

11.4.3 Route Journey Times

Figures 11.2 and 11.3 compare average modelled journey times along selected representative routes through the model network for the weekday 5:00-6:00pm and 6:00-7:00pm hours, respectively. The routes examined are shown in Figure K1 in **Appendix K** along with the detailed results in Table K1. For the 6,000 event, Figure 11.2 shows that there is an increase in journey time on a number of routes, although in most cases the increase is relatively small. The most notable increases are evident on routes between the A37 and the M32, and the A370 and the M32.

The route journey time comparisons highlight the much more significant impact on the network of a 12,000 event, with the greatest peak hour (5:00-6:00pm) increases occurring on routes between the M32 and A37, the A37 and the M32, and the A370 and the M32. The impact during the 6:00-7:00pm hour is also much more evident showing an extension of peak hour condition throughout this period with route journey times equivalent, or higher, than during the 5:00-6:00pm peak hour.

Figure 11.2: Route Journey Time Comparison, Weekday Evening (5:00-6:00pm)

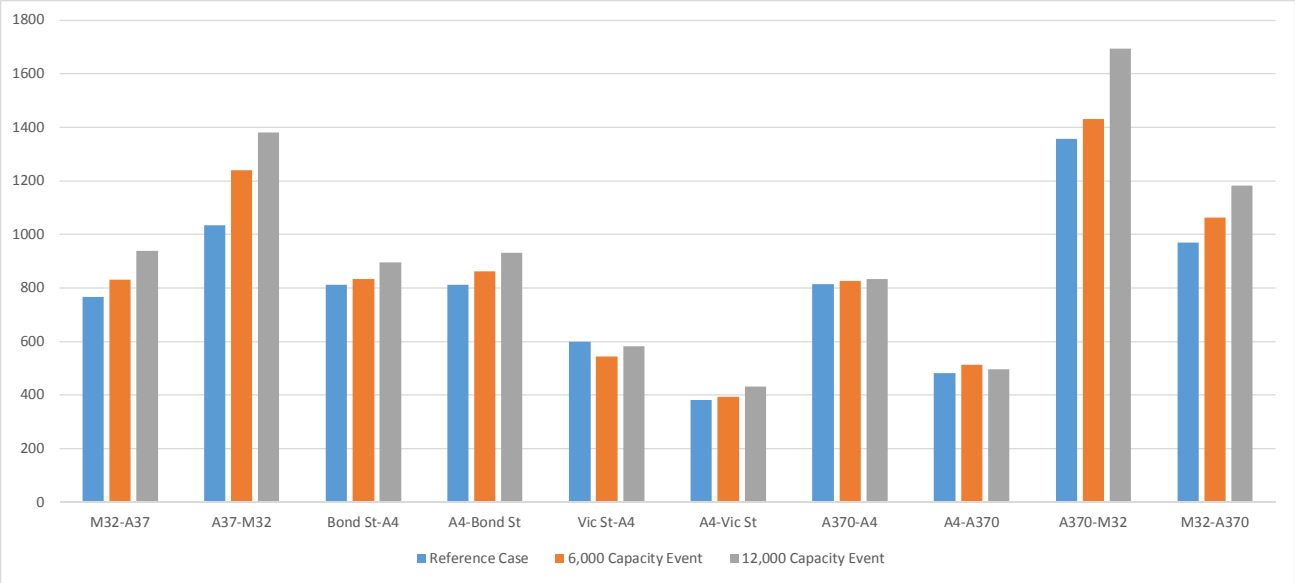
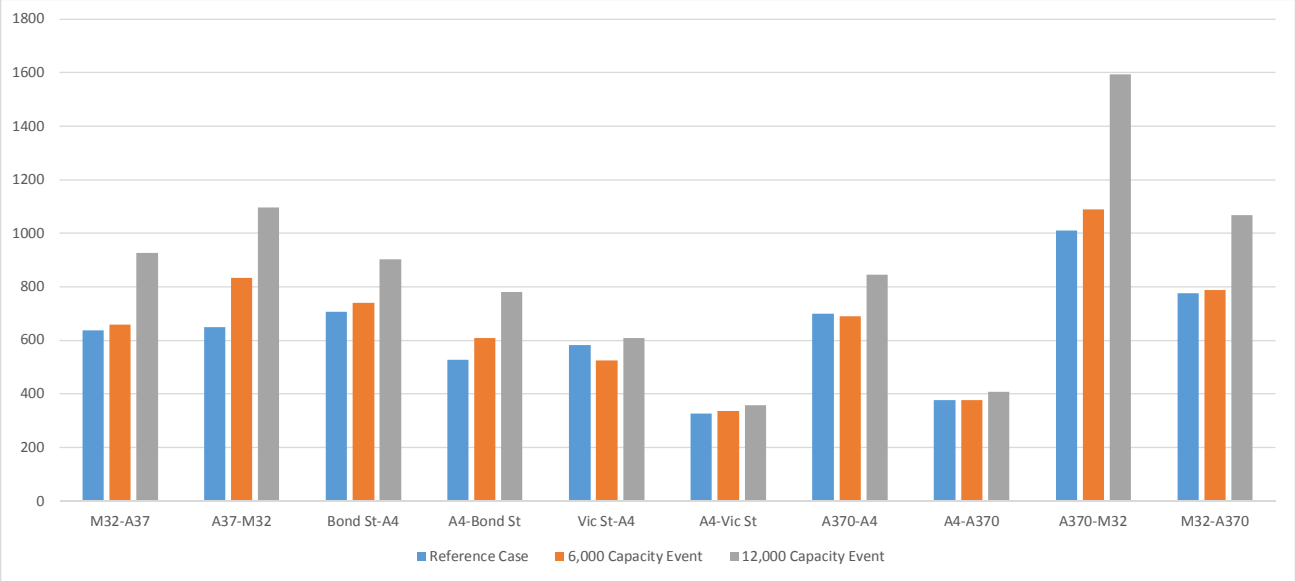


Figure 11.3: Route Journey Time Comparison, Weekday Evening (6:00-7:00pm)



11.4.4 Congestion Plots

To examine the change in network congestion under the Arena event scenarios, 'Normalised Congestion' plots have been created using modelled mean speed outputs. These plots are created by dividing the modelled mean speed by the 'free' link speed (typically the speed limit for the road). This creates a congestion index between 1 (free flow conditions) and 0 (static/slow moving conditions). These are then plotted on the network using bandwidths with one scenario, usually the Reference Case, overlaid on the Arena event scenario to highlight areas of change in congestion. These plots are provided in **Appendix K**. In simple terms the wider and darker the bandwidth then the more congested the link is, with the effect of queuing and slow moving traffic lowering the index.

Figures K2 and K3 in **Appendix K** compare the Reference Case and 6,000 event congestion for the weekday 5:00-6:00pm and 6:00-7:00pm hours. The plots highlight increases in congestion on the M32, A37 Wells Road and Bond Street entering the network. There are also less notable increases on Old

Market Street, Lower Castle Street and The Grove/Redcliffe Way. Within the network, there appears to be an increase in congestion eastbound along the New Cut, on Clarence Road and York Road approaching Bath Bridge roundabout. During the 6:00-7:00pm hour, much of this congestion appears to dissipate, although the plot still shows slow moving traffic on the A37 Wells Road compared to the Reference Case.

For the 12,000 event Figures K4 and K5 provide congestion plots comparing again the Reference Case for the weekday 5:00-6:00pm and 6:00-7:00pm hours. The plots highlight greater congestion, compared to the 6,000 event, on the M32, Wells Road, The Grove/Redcliffe Way and Bond Street. This scenario also shows an increase in congestion northbound on Temple Way, as well as on Clarence Road and York Road. Figure K5 for the 6:00-7:00pm hour shows that much of this congestion is sustained beyond the 5:00-6:00pm peak hour into the following hour.

11.4.5 Intersection Analysis

A series of journey time paths and queue routes were employed through the model networks in order to provide output on localised intersection performance. These paths and routes were coded between each major intersection stop line and were used to estimate arm-based delay (calculated as the mean journey time minus free flow journey time) and mean hourly queue lengths. This analysis was carried out for the 6,000 and 12,000 event scenarios, with comparison against Reference Case conditions for the 5:00-6:00pm and 6:00-7:00pm assessment hours. These intersection analysis tables are also presented in **Appendix K**.

Tables K2 and K3 in **Appendix K** compare the Reference Case and 6,000 event intersection outputs for the 5:00-6:00pm and 6:00-7:00pm assessment hours respectively. These highlight the following impacts:

- Increases in delay and queuing throughout most of the network during the 5:00-6:00pm peak hour are relatively modest with around 30 seconds higher delay, whilst some junction approaches show reduced delay and queuing arising from traffic displacement caused by Arena trips;
- There is a notable increase in delay on Houlton Street approaching Cabot Circus gyratory of around 200 seconds during both assessment hours. However, whilst this increase is large, it affects only circa 100 vehicles per hour. Furthermore, these vehicles could realistically reassign to the M32 or Old Market Street which have comparatively low increases in delay;
- There is an increase in delay on Redcliffe Bridge approaching Redcliffe Way roundabout of circa 60 to 70 seconds during both assessment hours, although mean queue lengths in other hours are not notably longer compared to the Reference Case;
- There is a notable increase in delay on the A37 Wells Road northbound approach to the St John's Lane junction of 119 seconds during the 5:00-6:00pm peak hour, with an associated increase in mean queuing of 50 metres compared to the Reference Case. However, this impact is diminished in the following 6:00-7:00pm hour; and
- There is an increase in delay of nearly 80 seconds compared to the Reference Case on the Temple Way underpass in the northbound direction approaching the Old Market Slip Road signals between 6:00 and 7:00pm. However, the delay is much less than the equivalent during the 5:00-6:00pm peak hour.

Similar comparative intersection results for a 12,000 event are shown in Tables K4 and K5 in **Appendix K**. Examination of these results highlights the following:

- There are notable increases in delay on a number of arms of Cabot Circus gyratory, including the M32, during both assessment hours, with the relative increase much more significant during the 6:00-7:00pm assessment hour;

- There is an increase in delay of 94 seconds compared to the Reference Case on the Temple Way underpass in the northbound direction approaching the Old Market slip-road signals during the 5:00-6:00pm peak hour. This relative change in delay increases to nearly 200 seconds compared to the Reference Case during the following 6:00-7:00pm hour;
- There are significant increases in delay on the Redcliffe Street and Redcliffe Way approaches to Redcliffe Way roundabout during both assessment hours. The increase in queuing and delay on the Redcliffe Way approach to the Temple Gate signals suggests that this could be associated with blocking back from this intersection into the roundabout; and
- An increase in delay on the A37 Wells Road northbound approach to the St John's Lane junction of over 150 seconds during the 5:00-6:00pm peak hour. Once again the impact is lower in the following 6:00-7:00pm hour, although the increase during this hour is much higher compared to the 6,000 event.

11.5 Model Outputs - Saturday Evening

This section provides a summary of the model outputs from S-Paramics for the Saturday evening (4:00-7:00pm) 6000 and 12000 MAX event scenarios. As before, the outputs represent an average from 20 separate random seed runs.

11.5.1 Network Performance

Table 11.7 compares the network performance outputs from S-Paramics for all scenarios modelled during the Saturday evening period (4:00-7:00pm). Again, the 2013 base year model output results have been included for completeness. The results suggest that both event sizes have little impact on the operation of the network. There is little change in mean network delay between the 2021 Reference Case and 6,000 event scenarios. Even the largest 12,000 Arena event only results in a small increase in mean network delay of 11 seconds compared to the Reference Case, together with a drop in mean network speeds by 1mph.

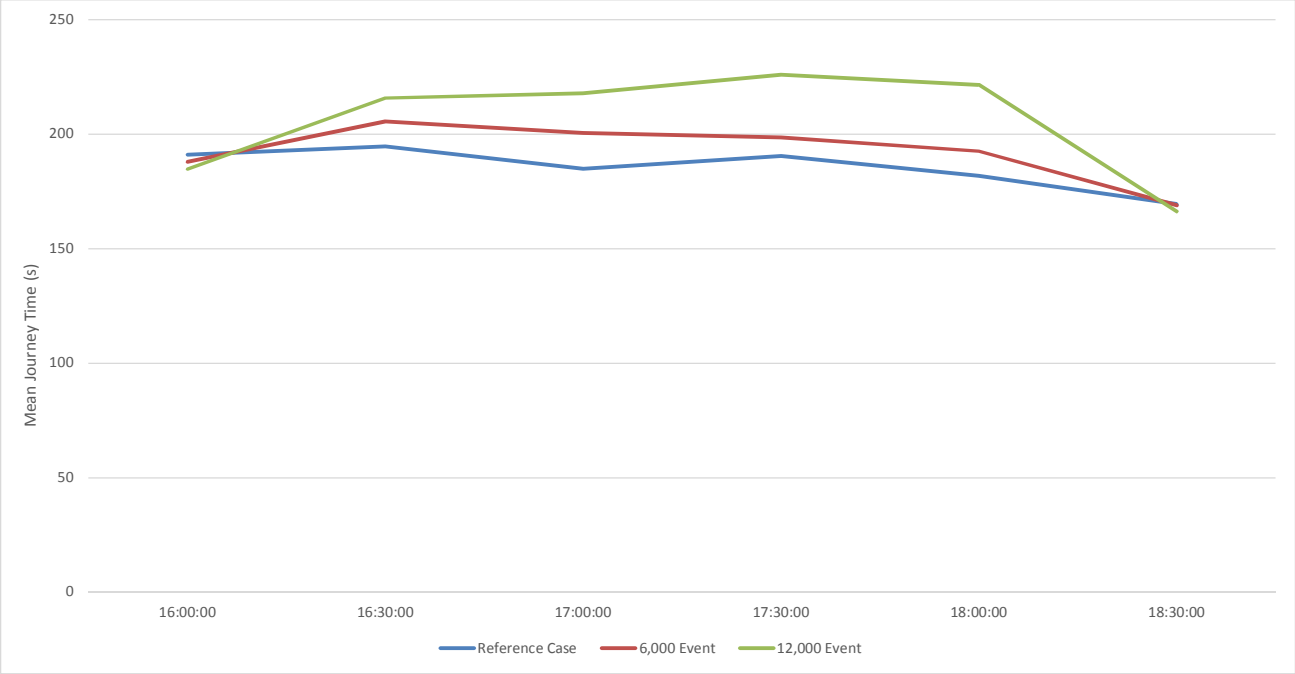
Table 11.7: Network Performance Statistics, Saturday Evening (4:00-7:00pm)

Network Variable	2013 Base	Reference Case	6000 Event	12000 Event
Mean delay (s)	262	263	266	274
Total distance (km)	66712	67838	69250	70086523
Vehs Entering Network	31582	32279	33164	33950
No. Vehs at 6:59pm	726	732	734	746
Journeys Completed	30856	31547	32429	33205
Network Demand	31251	31999	32881	33738
% Demand Satisfied	97.52%	97.31%	97.38%	97.20%
Mean Speed (mph)	18	18	18	17

Figure 11.4 compares the profile of network-wide mean journey times through the S-Paramics model network throughout the modelled Saturday evening period. The graphs confirms that the traffic associated with the 6,000 event increases mean network journey times by around 15 seconds throughout the modelled period, compared to the Reference Case. As expected, the 12,000 event has a

greater impact, although mean network journey times only increase by circa 50 seconds compared to the Reference Case scenario.

Figure 11.4: Network-Wide Mean Journey Times, Saturday Evening (4:00-7:00pm)



11.5.2 Traffic Flows

Table 11.8 shows the modelled traffic flows on the major routes entering the network for the Saturday evening 2021 Reference Case, and the change arising from the inclusion of the 6,000 event. The results show a fairly even distribution of traffic across entry links with most traffic entering the network via the M32 and Old Market Street. The totals highlight that most traffic arrives between 5:00 and 6:00pm.

Table 11.8: Modelled Traffic Flow into Network, 6,000 Event, Saturday Evening (4:00-7:00pm)

Route	**Reference Case**			**6,000 Event (Traffic Change)**		
	4-5pm	5-6pm	6-7pm	4-5pm	5-6pm	6-7pm
M32 Newfoundland Street	1550	1561	1606	25	107	58
Houlton Street	118	126	121	4	16	15
A420 Old Market Street	955	854	870	57	102	57
A4 Bath Road	483	514	514	-4	10	-6
A37 Wells Road	712	705	670	10	23	14
St John's Lane	264	258	247	15	28	20
St Lukes Road	312	250	266	3	14	7
A38 Bedminster Parade	612	622	592	-1	4	-2
A370 Coronation Road	603	599	501	7	36	18
Commercial Road	332	336	247	-10	5	4

Table 11.8: Modelled Traffic Flow into Network, 6,000 Event, Saturday Evening (4:00-7:00pm)

Route	Reference Case			6,000 Event (Traffic Change)		
Redcliffe Bridge	291	337	301	12	15	-1
Victoria Street	395	377	360	2	18	4
Lower Castle Street	782	760	716	-9	10	2
A4044 Bond Street	1878	1772	1461	8	28	14
TOTAL ENTERING	**9286**	**9069**	**8472**	**119**	**417**	**203**

Table 11.9 provides the same comparison in traffic entering the Saturday evening S-Paramics model by hour for a 12,000 event. The results show a similar pattern of increases to the 6,000 event, albeit much greater in magnitude.

Table 11.9: Modelled Traffic Flow into Network, 12,000 MAX Event, Saturday Evening (4:00-7:00pm)

Route	Reference Case			12,000 MAX Event (Traffic Change)		
	4-5pm	5-6pm	6-7pm	4-5pm	5-6pm	6-7pm
M32 Newfoundland Street	1550	1561	1606	75	303	185
Houlton Street	118	126	121	3	19	19
A420 Old Market Street	955	854	870	86	167	106
A4 Bath Road	483	514	514	2	19	4
A37 Wells Road	712	705	670	13	39	23
St John's Lane	264	258	247	27	55	39
St Lukes Road	312	250	266	3	19	8
A38 Bedminster Parade	612	622	592	1	7	1
A370 Coronation Road	603	599	501	8	47	25
Commercial Road	332	336	247	-15	6	4
Redcliffe Bridge	291	337	301	7	7	-4
Victoria Street	395	377	360	-12	8	-6
Lower Castle Street	782	760	716	-5	12	6
A4044 Bond Street	1878	1772	1461	27	68	42
TOTAL ENTERING	**9286**	**9069**	**8472**	**220**	**774**	**451**

The traffic flow results for the 6,000 and 12,000 events suggest that most of the increase in traffic associated with the Arena was able to enter and pass through the model network during the simulated time period. Further checks using the 'releases' output confirms that there were no significant unreleased volumes of traffic in any modelled hour in either Arena scenario. Consequently, the unreleased traffic output has not been presented.

11.5.3 Route Journey Times

Figures 11.5 and 11.6 compare average modelled journey times along selected representative routes through the model network for the Saturday 5:00-6:00pm and 6:00-7:00pm assessment hours, respectively. The routes examined are shown in Figure K1 in **Appendix K** with the detailed results presented in Table K6. The graphs show that for both 6,000 and 12,000 Arena events there is little impact on journey times through the network in either of the assessment hours.

Figure 11.5: Route Journey Time Comparison, Saturday Evening (5:00-6:00pm)

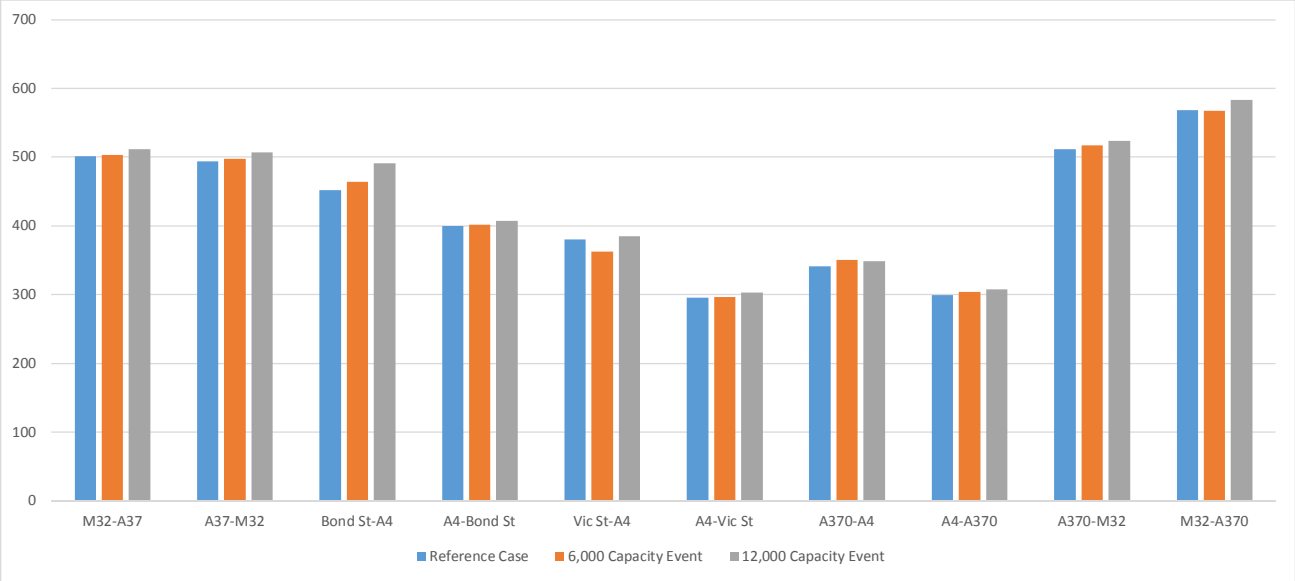
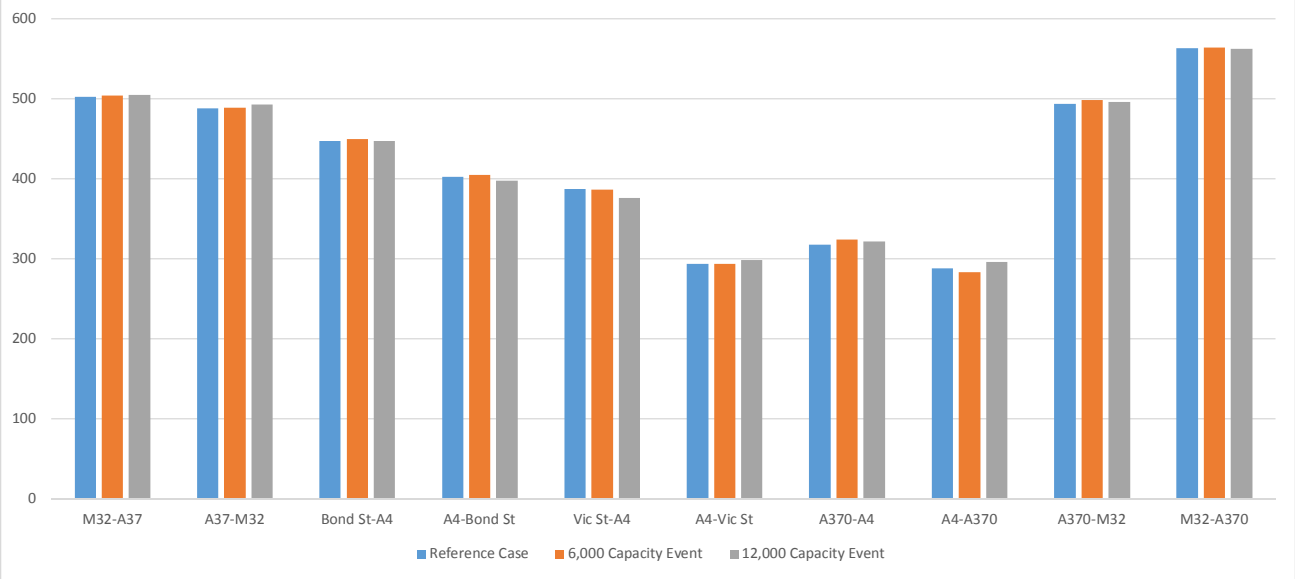


Figure 11.6: Route Journey Time Comparison, Saturday Evening (6:00-7:00pm)



11.5.4 Congestion Plots

Appendix K contains normalised congestion plots for the Saturday evening 6,000 and 12,000 MAX Arena events (5:00-6:00pm and 6:00-7:00pm assessment hours). As before, these are overlaid on the Reference Case plots to highlight areas where the Arena traffic is increasing congestion. However, examination of Figures K6 and K7 for a 6,000 event, and Figures K8 and K9 for the 12,000 event, show

that there is little or no change in network congestion. There is a slight increase evident on Lower Castle Street with both event sizes, and small increases in congestion on approaches to Cabot Circus gyratory with a 12,000 event between 5:00-6:00pm.

11.5.5 Intersection Analysis

Tables K7 and K8 in **Appendix K** respectively compare the Reference Case and 6,000 event intersection outputs for the Saturday 5:00-6:00pm and 6:00-7:00pm assessment hours. These confirm the minimal impact of this Arena event size on network operation. The only notable impact is on the Houlton Street approach to Cabot Circus gyratory, which sees an increase in delay of 72 seconds between 5:00 and 6:00pm. However, this impact is much lower in the following hour.

The same comparative intersection results for a 12,000 capacity event are shown in Tables K9 and K10 in **Appendix K**. Examination of these tables again shows little notable impact across the network with the only significant increase in delay occurring on Houlton Street. Since other alternative routes show little increase in delay, it is likely that vehicles using this route could divert mitigating this impact.

11.6 Model Outputs - Saturday Daytime

This section provides a summary of the model outputs from S-Paramics for the Saturday daytime (12:00-3:00pm) back-to-back 6,000 matinee scenario. .

11.6.1 Network Performance

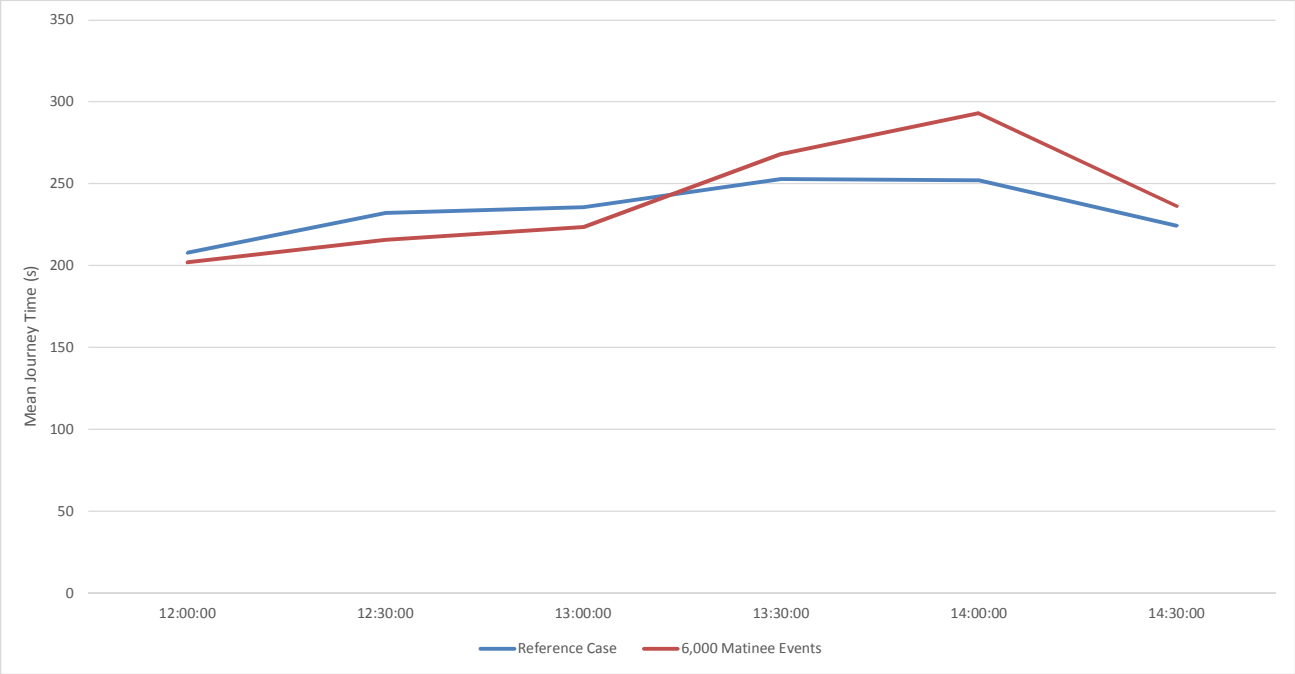
Table 11.10 compares the network performance outputs from S-Paramics for the Reference Case and 6,000 matinee event scenarios modelled during the Saturday daytime period (12:00-3:00pm). As before, the 2013 base year model output results have been included for completeness. The results show that the 6,000 matinee events lead to a small deterioration in aggregate network performance, increasing mean network delay by 22 seconds and reducing mean network speeds by 1mph.

Table 11.10: Network Performance Statistics, Saturday Daytime (12:00-3:00pm)

Network Variable	2013 Base	Reference Case	6000 Matinees
Mean delay (s)	313	319	341
Total distance (m)	70697	72532	73877
Vehs Entering Network	35172	36077	36597
Current Vehs at 2:59pm	1206	1216	1397
Journeys Completed	33966	34862	35201
Network Demand	34992	35926	36986
% Demand Satisfied	95.99%	95.91%	94.08%
Mean Speed (mph)	14	14	13

Figure 11.7 compares the profile of network-wide mean journey times through the S-Paramics model network throughout the modelled Saturday daytime period (12:00-3:00pm). The graph shows that it is only when visitors from the morning event begin to leave, coinciding with visitors arriving for the afternoon event, that network-wide mean journey times are higher compared to the Reference Case. However, this increase is not significant and equates to only around 50 seconds during the worst half hour period.

Figure 11.7: Network-Wide Mean Journey Times, Saturday Daytime (12:00-3:00pm)



11.6.2 Traffic Flows

Table 11.11 shows the modelled traffic flows on the major routes entering the network for the Saturday daytime 2021 Reference Case, and the change arising from the inclusion of the 6,000 matinee events. The results show a fairly even distribution of traffic across entry links, with most traffic entering the network via the M32 and Redcliffe Bridge, as well as Bedminster Parade, Lower Castle Street and Bond Street. The totals highlight that most traffic arrives in the 1:00-2:00pm hour.

Table 11.11: Modelled Traffic Flow into Network, 6,000 Matinee Events Saturday Daytime (12:00-3:00pm)

Route	**Reference Case**			**6,000 Matinees (Traffic Change)**		
	12-1pm	1-2pm	2-3pm	12-1pm	1-2pm	2-3pm
M32 Newfoundland Street	2005	1779	1805	58	138	55
Houlton Street	62	79	87	0	3	6
A420 Old Market Street	1165	1350	1362	6	17	-62
A4 Bath Road	623	605	569	-22	-13	-15
A37 Wells Road	799	755	676	-4	4	2
St John's Lane	303	288	238	-4	-6	-5
St Lukes Road	392	387	392	7	11	11
A38 Bedminster Parade	793	759	750	5	21	32
A370 Coronation Road	921	896	834	-70	-43	-45
Commercial Road	425	411	417	-30	-17	-20
Redcliffe Bridge	199	223	240	21	73	101

Table 11.11: Modelled Traffic Flow into Network, 6,000 Matinee Events Saturday Daytime (12:00-3:00pm)

Route	Reference Case			6,000 Matinees (Traffic Change)		
Victoria Street	419	429	432	-35	-20	-31
Lower Castle Street	463	478	481	-17	28	35
A4044 Bond Street	1613	1508	1888	-26	27	25
TOTAL ENTERING	**10182**	**9945**	**10171**	**-110**	**224**	**87**

Since this is the only Arena scenario that includes visitor departures, Table 11.12 shows the modelled traffic flows on the major routes exiting the network for the Saturday daytime scenario. The results highlight the surge in Arena departures between 2:00 and 3:00pm, with most traffic exiting via the M32 and Old Market Street.

Table 11.12: Modelled Traffic Flow exiting Network, 6,000 Matinee Events Saturday Daytime (12:00-3:00pm)

Route	Reference Case			6,000 Matinees (Traffic Change)		
	12-1pm	1-2pm	2-3pm	12-1pm	1-2pm	2-3pm
M32 Newfoundland Street	1839	2034	2183	4	122	216
Houlton Street	418	437	452	-17	-16	-7
A420 Old Market Street	518	547	540	-7	19	25
A4 Bath Road	561	607	596	-38	-26	-10
A37 Wells Road	663	704	662	-19	-10	2
St John's Lane	451	475	460	-17	-17	-19
St Lukes Road	393	454	454	-13	-21	-5
A38 Bedminster Parade	376	401	402	-12	-11	-10
A370 Coronation Road	803	873	891	-27	-21	-17
Commercial Road	316	340	342	-6	6	11
Redcliffe Bridge	278	304	300	-16	-18	-9
Victoria Street	335	361	341	-1	4	11
Lower Castle Street	251	278	257	2	10	10
A4044 Bond Street	1377	1625	1634	-4	-2	-1
TOTAL EXITING	**8578**	**9441**	**9515**	**-171**	**18**	**196**

As with the Saturday evening results, checks using the 'releases' output confirms that there were no significant unreleased volumes of traffic on major routes entering the model area in any modelled hour during the Saturday daytime test period, with the exception of an increase in unreleased traffic on Old Market at 3:00pm of 54 vehicles compared to the Reference Case. Consequently, the unreleased traffic output has not been presented.

11.6.3 Route Journey Times

Figures 11.8 and 11.9 compare average modelled journey times along selected routes through the model network for the Saturday daytime 1:00-2:00pm and 2:00-3:00pm assessment hours, respectively. The routes examined are shown in Figure K1 in **Appendix K** with the detailed results presented in Table K11. The graphs show little significant changes in journey times between 1:00 and 2:00pm. During the 2:00 to 3:00pm hour, there are increases in journey times on routes from the M32, with the M32 to A370 route experiencing an increase of circa 180 seconds.

Figure 11.8: Route Journey Time Comparison, Saturday Daytime (1:00-2:00pm)

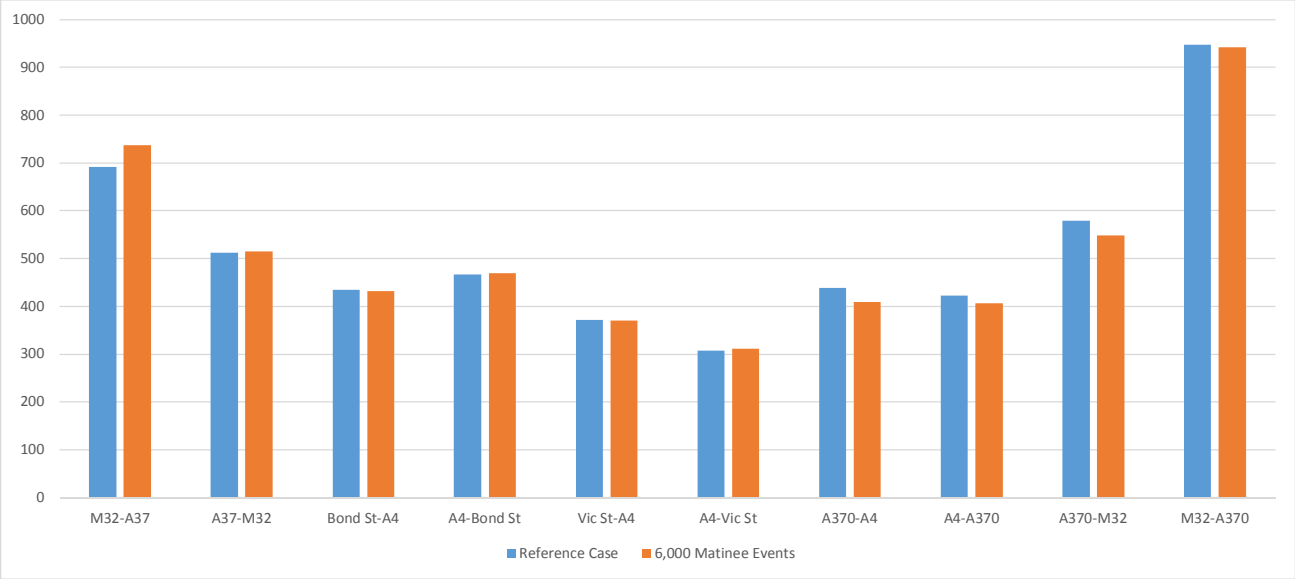
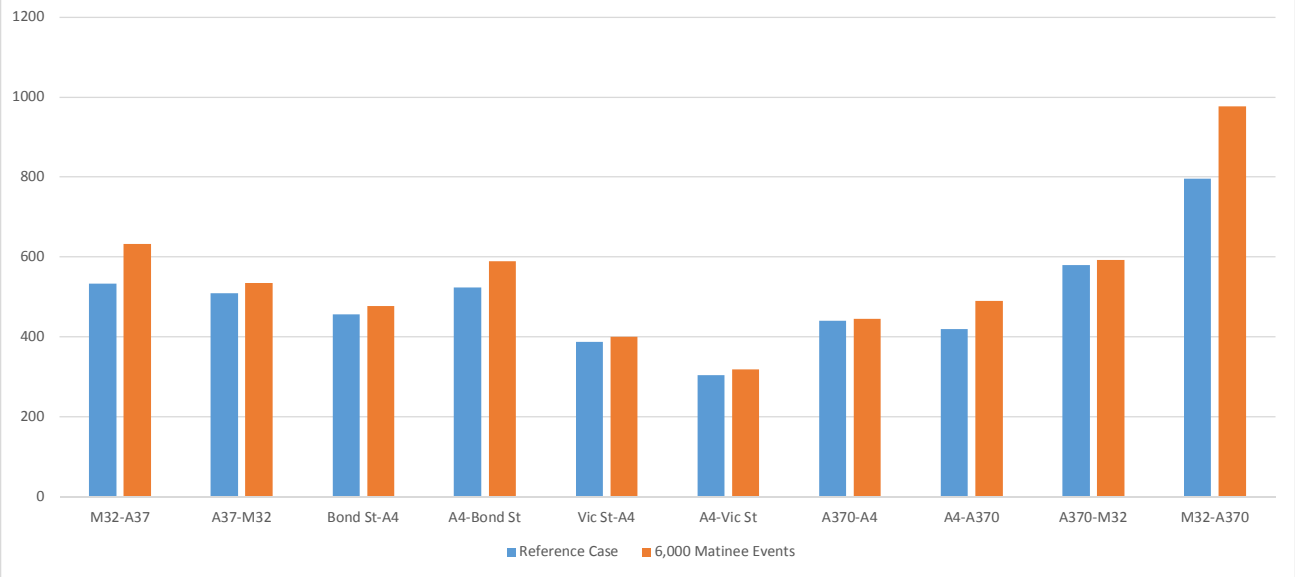


Figure 11.9: Route Journey Time Comparison, Saturday Daytime (2:00-3:00pm)



11.6.4 Congestion Plots

Normalised congestion plots for the Saturday daytime 6,000 matinee Arena events (1:00-2:00pm and 2:00-3:00pm assessment hours) are also included in **Appendix K**. As before, these are overlaid on the Reference Case plots (blue) to highlight areas where the Arena traffic is increasing congestion (red).

Examination of the plots suggests that there is no notable increase in congestion between 1:00 and 2:00pm. During the 2:00 to 3:00pm hour, the plot highlights increased congestion compared to the Reference Case on the M32, Bedminster Parade, Redcliffe Way, Redcliff Hill and along the New Cut on York Road and Clarence Road.

11.6.5 Intersection Analysis

Tables K12 and K13 in **Appendix K** compare the Reference Case and 6,000 matinee events intersection outputs for the Saturday 1:00-2:00pm and 2:00-3:00pm assessment hours respectively. Examination of the results shows no notable change in delays between 1:00 and 2:00pm. The coincidence of Arena arrivals and departures between 2:00 and 3:00pm has a greater impact, with increases in delays of circa 80 seconds on a number of junction arms, such as the M32, Old Market Street, and York Road approaching both Bath Bridges and Bedminster Bridge roundabouts.

11.7 Wider Impact on the Strategic Road Network - SRN

As noted earlier in discussing a typical visitor catchment for Arena events, a high proportion of spectators could travel from outside of the WoE area. This is a very likely scenario for the largest events with a regional draw. A number of major population centres in the catchment area lie to the north, west and east of Bristol, where use of the M4 or M5 is likely to be the most logical route choice for visitors coming by car. As such, the results from the GBATS model have been used to assess the effects on the Strategic Road Network (SRN). The same 2021 event scenarios on a weekday and Saturday have been considered in respect of flow changes on the SRN. However, the GBATS model has only been calibrated and validated for a weekday 5:00-6:00pm period, so not the extended 3:00-8:00pm period covered in the City Centre S-Paramics model. Furthermore, there is no Saturday GBATS model, so in this case predicted visitor traffic flows on the SRN are simply compared with Highways England 'Traffic Flow Data System' (TRADS) data, where this is available for the main-line links and slip-roads.

The outcome of the analyses showing the flow changes on the SRN in the weekday 5:00-6:00 period and the 1:30-2:30pm and 4:30-5:30 periods on a Saturday are set out in a separate Technical Memorandum included in **Appendix L**. As with the S-Paramics work, the weekday evening scenarios consider 6,000 and 12,000 capacity events, and the same event sizes on a Saturday evening. The daytime scenario on Saturday considers the changeover period between two 6,000 events so, in this case, both visitor arrivals and departures are assessed. It should be noted that the Arena traffic volumes assigned in GBATS were only the proportions expected in the time periods identified, so 30% in the weekday 5:00-6:00pm period. So volume changes affecting the SRN will in practice occur over a longer period, with 4:30-7:30pm profiles assumed for the weekday evening and Saturday evening events as discussed earlier.

It is important to note that the GBATS plots included as an appendix to the Technical Memorandum show the distribution of 'assigned' visitor trips only which, as expected, shows a predominant route choice into/out of the City Centre via the M32. In contrast there is predicted to be little impact on the northbound length of the M5 between Junctions 20 and 15. The reason for the latter is that expected visitor traffic from Bridgewater/Taunton is assigned via GBATS to the A370 and A38 corridors into the City Centre, so traffic using the SRN leaves at M5 Junction 21. Tables 3.1 and 3.2 identify these visitor trips in the weekday 6,000 and 12,000 event situations in absolute terms, but also show the predicted 'net' change in the overall flow on the selected SRN main-line sections and slip-roads. This is because the GBATS model directly models the weekday 5:00-6:00pm period, so in this case any allied diversionary impacts on existing traffic can be and are included. In contrast the Saturday flow change analyses presented in Tables 3.3 and 3.4 can only compare the expected visitor traffic flows with existing TRADS information, so any existing traffic re-routing responses are ignored.

Looking at the weekday situation on the main-line SRN links in Table 3.1 (Appendix L) shows that:

- When compared with 2014 TRADS data the expected 2021 Reference Case traffic volumes do, in nearly all cases, show a growth in directional flows as might be expected. The only noticeable drop predicted by 2021 is the M4 section between Junctions 18 and 19. However, the absolute Arena visitor impact here with even the largest 12,000 event is only 142 westbound trips, or 147 vehicles in 'net' terms;

- The links attracting the highest numbers of visitor trips in both the 6,000 and 12,000 scenarios are the M4 southbound section from Junction 20 to Junction 19 (M32), and the three southbound sections of the M32. In the 12,000 maximum capacity event scenario the number of inbound visitor trips using the length of the M32 is around 500vph between 5:00-6:00pm. However, the effect of diversionary impacts reduces the worst case net increase to 282 vehicles on the section of the M32 between Junctions 1 and 2 (circa +9% change); and

- As noted in this Transport Assessment in Chapter 8, the largest 12,000 events are only likely to occur on about 20 occasions per year, and even then some of these may be scheduled for a Saturday evening. With regard to the latter, a TRADS flow comparison shows that the expected visitor 'high load' sections on the SRN are much less heavily trafficked on a Saturday.

The link flows expected on a Saturday in Table 3.3 (Appendix L) show that:

- With a 12,000 event on the Saturday evening the expected number of visitor trips routing the length of the M32 is circa 600-650vph between 4:30-5:30pm. This is higher than the weekday 5:00-6:00pm period as 40% of trips are expected to arrive in this hour on Saturday; and

- The above would result in predicted +15% and +18% increases in the existing southbound flows on the M32 sections between M4 Junction 19-Junction 1 and Junctions 1-2 respectively. However, this takes no account of any ancillary diversionary or displacement effects on existing traffic which might occur. Notwithstanding this, the increased southbound flows do not exceed those observed in TRADS for the same sections on a weekday between 5:00-6:00pm. The degree to which the Newfoundland Street approach to Cabot Circus Roundabout may serve to constrain this increased demand at the City Centre end of the M32 corridor on a late Saturday afternoon has been separately considered and reported in the more detailed S-Paramics modelling.

11.8 Traffic Impact Overview

11.8.1 General

This Section has presented the results of GBATS/S-Paramics micro-simulation traffic modelling comparing network performance between 2021 Reference Case scenarios and a series of Arena event scenarios. This has been carried out for the weekday 3:00-8:00pm and Saturday 12:00-3:00pm and 4:00-7:00pm time periods. The results are 'worst case', assuming no specific measure to mitigate the impact of Arena event traffic. Additionally, the assessment is considered to be highly robust in view of the following:

- The Arena has been tested in conjunction with circa 2 to 3 per cent traffic growth in all time periods modelled. Traffic data for Bristol City Centre shows that traffic entering the network has been declining over several years, not growing;
- Traffic generation assumptions for the Arena are extremely robust and assume that events are entirely sold out, even though operator feedback suggests that events are typically only 80 to 90 per cent of tickets are usually sold. Furthermore, the traffic generation assumes a high proportion of visitors travel to events by car rather than by public transport, with a robust level of mean car occupancy assumed; and

- Traffic signals timings retain base model setting for all time periods modelled. Since the city centre operates under SCOOT, in reality traffic signals timings and offsets within the network are adaptive and will respond to changes in traffic flow. This will mitigate some of the impact of Arena traffic, particularly outside of peak periods when SCOOT has more scope to adapt.

11.8.2 S-Paramics Model Results

The S-Paramics modelling assessment has shown that the impact of a 6,000 capacity Arena event during the weekday evening peak period is expected to be, in aggregate terms, modest. The results show that there is expected to be some localised impacts during the 5:00-6:00pm peak hour, commensurate with the scale of increased traffic attracted into the City Centre, although these impacts dissipate once evening background traffic levels begin to abate. Taking this into consideration, as well as the highly robust approach to the modelling set out above, it is not considered that the impact of a 6000 Arena event during this period is likely to be severe, or that it merits special mitigation measures.

Similarly, the assessment has shown that, with the lower levels of background traffic and congestion evident during this period, the 6,000 matinee, and 6,000 and 12,000 evening events can be accommodated on Saturdays without significant detriment to the highway network tested. The Saturday 6,000 matinee events, which already benefit from higher public transport opportunities, are predicted to have some impact on network operation, although in aggregate terms the impact is relatively minor with modest localised increases in queuing and delay that are not considered to be severe. Consequently, it is not believed that events held on Saturdays require further mitigation.

However, without special mitigation measures, the maximum capacity 12,000 events held on a weekday evening are expected to have a significant detrimental impact on the operation of the network modelled. The results for this event size on this day show a notable worsening of conditions during the peak hour (5:00-6:00pm) with this congestion taking some time to abate. Examination of traffic flows and unreleased vehicles also show extensive edge congestion beyond the extents of the network on key routes such as Bond Street, which would entail impacts outside of the model network. Whilst some allowance can be made in view of the robust nature of the assessment, it is expected that the impacts of a 12,000 event on a weekday evening will be severe and will require mitigation aiming to limit the number of car journeys into the area.

11.8.3 Wider Effect on the SRN - GBATS Results

The modelling using GBATS is limited to the 5:00-6:00pm hour on a weekday, and a comparison with existing TRADS data for the SRN on a Saturday as no validated model is available for this period. As expected, the visitor routing analyses for the same 6,000 and 12,000 event scenarios show a predominant use of the M32 corridor as a primary access route for those coming by car. However, looking at a 'worst case' 12,000 maximum capacity event on a weekday, the highest net increase on the M32 between Junctions 1 and 2 is circa 300vph between 5:00-6:00pm. Whilst some of this southbound visitor traffic is predicted to leave the M32 at Junction 3, most continues into the City Centre via Newfoundland Street. To the north of the M32 the biggest net change of around 200 vehicle trips occurs on the southbound section of the M4 between Junctions 20-19. However, this equates to an increase of only +4% in the predicted 2021 Reference Case flow between 5:00-6:00pm, which growth effects suggest will already be around 800 vehicles higher than the observed 2014 TRADS flow by 2021. As such, the highest potential event generation in net terms is only 25% of the general growth expected to occur over the 2014-2021 period with no Arena. The fact that the former will occur on no more than 18-20 occasions, and possibly less given some of the 12,000 events may occur on a Saturday evening, thus needs to be taken into context,.

The Saturday results presented in Appendix L are a 'worst case' as they do not reflect any displacement of background traffic. Despite some percentage increases in relation to TRADS data appearing significant

on the M32 in particular, the existing background flows are generally lower on a Saturday than on a weekday PM peak hour. Indeed, the highest changes occurring on the southbound M32 with a 12,000 capacity evening event do not result in overall flows which exceed the existing observed TRADS flows accommodated during a weekday between 5:00-6:00pm.

Event Specific Mitigation and Management

12.1 Introduction

This Chapter sets out the additional mitigation which would need to be put in place to cater for expected visitor demands associated with large Arena events, with an expected attendance of 9,000-12,000 people. Based on the 'worst' case' modelling results described earlier this will be necessary to discourage a large number of visitors from driving into the City Centre, with associated highway operating and parking impacts. Not unexpectedly these events will be the evening events where the 'worst case' car occupant mode share is expected to be 80% without appropriate additional public transport measures put in place to discourage driving into the City Centre.

12.2 Management and Coordination

The event management plans to be put in place for specific scenarios, and particularly the large 12,000 events, will require quarterly planning meetings between the Arena operator and all key stakeholders involved in transport provision or management. Critical to this will be a BCC Co-ordinator, whose part or full time job function will be to ensure, through appropriate liaison, that all off-site transport mitigation is properly planned/put in place. The Arena operator has confirmed that this local authority 'link' person is a key player in the event planning at other Arena sites they currently operate. The stakeholder group who would meet quarterly would be expected to include the following, although the list is not exclusive:

- The Arena operator: who would provide the list of events/timings/capacities for the forthcoming quarter;
- The operator's Travel Plan Coordinator (TPC);
- BCC - Coordinator;
- BCC - Public Transport representative;
- BCC - Network Management representative;
- Great Western Railway - Rail;
- Highways England - SRN Network Management;
- Police; and
- Traffic Management contractor (TTM)

It should be noted that a series of Event Management Plans will need to be developed over time to deal with different scenarios, whether a specific plan needed for a bespoke large 12,000 event, or a plan to deal with the concurrent occurrence of an event at the Arena and something else happening in the city such as Bristol City FC playing a home match. In other words there will not be a set or single Event Management Plan for operating all events at the Arena. A Framework Event Management Plan (FEMP) has been developed as part of the Travel Plan to outline the process and possible interventions, which includes those to be put in place by the operator to safely manage the flows of visitors and vehicles on Arena Island during events. Management and operation of the Arena and the immediate Island site is not discussed in this TA, but sections below outline the wider transport measures to be included in event plans for the large events.

12.3 Proposed Event Plan Interventions

12.3.1 Temporary Road Closures and Restrictions

12.3.1.1 Cattle Market Road: Bath Road to HCA Bridge

For all or certainly the large evening events it would be proposed to close the section of Cattle Market Road between the A4 Bath Road and the HCA Bridge to all traffic. This length of Cattle Market Road will be permanently altered by current works to close it in the westbound direction, so the temporary closure during events will only affect the remaining eastbound carriageway. This will be done to cater for increased footfall along this road, which will be a key approach/departure route used by spectators walking between the City Centre and Arena Island. To prevent an unacceptable impact on traffic operation in the Temple Gate area, particularly during the weekday evening peak hour, the closure will not be put in place until 6:00pm. It is anticipated it would be lifted after midnight, when most if not all of the crowd leaving a late night event will have dissipated.

12.3.1.2 Cattle Market Road: HCA Bridge to Feeder Road/Albert Road Junction

This section of Cattle Market Road will not be closed to vehicular traffic, but westbound access to Arena Island will be marshalled to allow only disabled/concessionaire vehicle access during, say, the one and a half hour period preceding an evening event. With the secondary development in place on Arena Island in Phase 2, vehicular access rights in this pre-event period would need to be extended to essential permit holders and residents.

12.3.1.3 Albert Road: Stanhope Street to Feeder Road

This proposed closure was discussed earlier in the TA when describing the operation of the proposed coach drop-off/pick-up area at the northern end of Albert Road. As stated then it would be proposed to close the section of Albert Road between Stanhope Street and Feeder Road to general traffic between 6:00pm and midnight. The objective of doing this would be to reduce conflict between coaches, pedestrians and drivers seeking on-street parking or looking to set-down passengers in this zone prior to and after events taking place at this time.

The 'through' closure of Albert Road will require additional temporary signing at the Albert Road/Totterdown Bridge junction to advise drivers, although any drivers routing northbound on Albert Road in error, or to look for parking, will be able to access Feeder Road via Stanhope Street/Chapel Street/Short Street.

12.3.2 Park and Ride: Extended Operation

12.3.2.1 Event Size/Logistics

Large events attracting up to 12,000 attendees are predicted to occur at the venue between 7:30 and 11:00pm on weekdays and Saturdays. However, Park and Ride is currently unable to play a role in the movement of spectators from these events. The existing Park and Ride sites at Brislington, Portway and Long Ashton close at 9:30pm on a weekday and 8:00pm on Saturday, with the exception of Long Ashton which stays open to 9:30pm. As such, whilst normal operation would cater for visitor arrivals, extended operation and a bespoke pick-up operation would be needed to provide high capacity to cater for a short departure 'window' after an Arena event;

It is thus proposed to extend use of the Park and Ride to cater for the large visitor demands expected with evening events on a weekday and a Saturday. If used for maximum capacity 12,000 events this would equate to 18-20 times/annum on the basis of the typical event type/capacity programme provided by the proposed operator. If used for events with predicted attendances >9-10,000 this would give rise to a need to service 45 events/annum, or around 12 per quarter (about once a week);

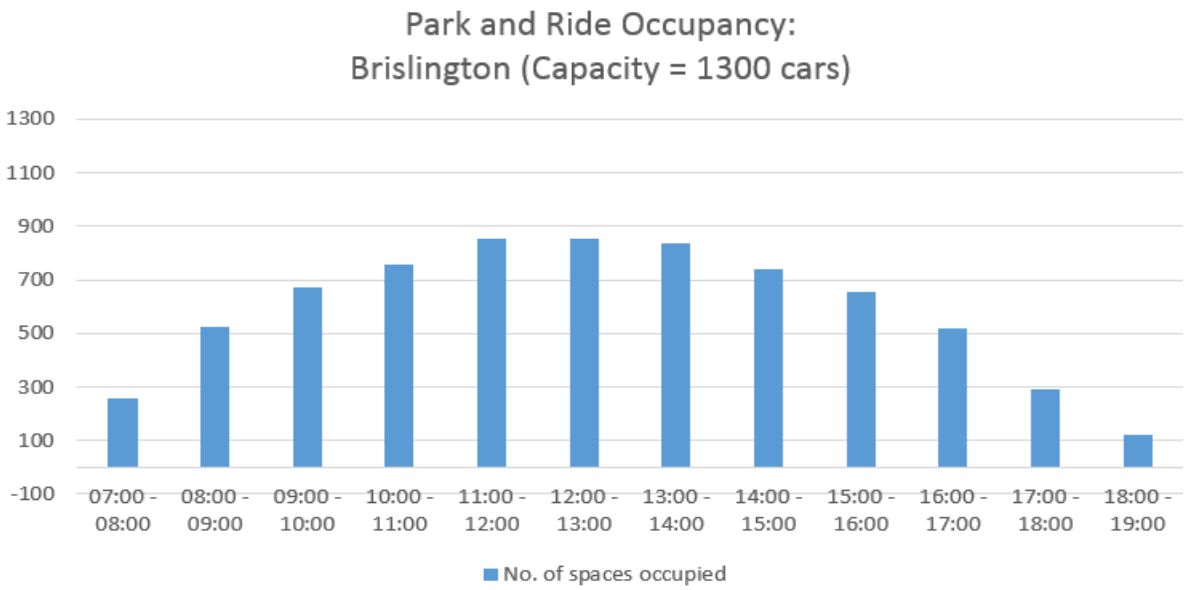
Discussion with the Bristol City Council Public Transport team has confirmed a 'rolling bus replacement' operation could be provided using the fleet in operation for the Brislington and Long Ashton sites. The proximity of these sites allow a round trip to be completed in about 25 minutes. Assuming a first bus on stand leaves at 11:30pm, and the last leaves at 00:30 (guaranteed last bus) it is estimated that 12 pick-ups could be achieved from each of the Long Ashton and Brislington sites. Only 6 pick-ups could be achieved in this period using the A4 Portway site, which has a much longer round-trip journey time of 45 minutes. As such, the use of Portway is not considered in the extended Park and Ride operation. With a maximum capacity of 75 persons per bus (no standing) the total potential capacity across both sites would be 1,800. However, allowing for a degree of latency, say 85% take-up, the potential draw-off is 1,530 visitors. This equates to a reduction of about 640 cars which would otherwise seek to drive into the City Centre and park. Using the 'worst case' mode shift for an evening event the expected volume of visitor car traffic is around 3,500 vehicles without Park and Ride being available. As such, a potential reduction of circa 18% is achievable with an extended Park and Ride using just these two sites.

A 'pick-up' zone within a relatively convenient walk distance of the Arena site, catering for both services and with sufficient capacity to accommodate 'on stand' and back-up buses is needed. It is proposed that the 'pick-up' zone at the end of an Arena event will be Redcliffe Way, with the kerbside space in both directions used for Brisington and Long Ashton services respectively, including the lay-over/parking of 'follow up' buses.

The base-line operating cost associated with the extended service for each site has been provided by the Council's public transport officers and is £1,300, so **£2,600** per event with both services used. The actual 'net' cost will depend on the revenue generated by Arena users and the ticket pricing adopted for people holding Arena tickets by the Council's public transport team. Potential financial contribution costs/annum will therefore be dependent on the event size 'trigger' used to invoke extended Park and Ride. Assuming full cost reimbursement irrespective of revenue, and limiting operation to the 20 events of maximum 12,000 size expected, would require a sum of **£52K/**annum. Adopting a lower event size target trigger of 9-10,000 would require **£117K**/annum.

Given the demonstrated capacity potential for reducing visitor car traffic routing into the City Centre, and in keeping with Bristol's 'Green City' agenda, it is proposed that extended Park and Ride is used to support all evening events >9,000 capacity. 'Worst Case' modelling testing the impact of a 6,000 capacity evening event on a weekday and Saturday has shown that extending Park and Ride for these will not be a requirement. Furthermore, doing so for the smaller events would require a fairly frequent call on extended operation, and associated escalation of operating costs. As mentioned earlier, the Arena operator and BCC Coordinator would need to forward plan this Park and Ride provision on a quarterly basis with the Council's Public Transport officers, once the impeding event programme is known and capacities planned for.

The strategy does of course depend on parking capacity being available in the Brislington and Long Ashton sites from around 4:30pm onwards on a weekday and Saturday. A typical weekday profile available for the Brisington site below shows that, not unexpectedly, the number of occupied spaces drops off during the afternoon, with spare capacity around 60% or nearly 800 spaces by 4:00-5:00pm. Furthermore, at this time of day, most Park and Ride buses travelling inbound to the city centre are largely empty, with peak commuter demand occurring in the outbound direction.



12.3.2.2 Pre-Booking Park and Ride with Arena Ticket Purchase - Feasibility/Benefit

The concept of using a proposed pre-booking arrangement for Park and Ride, so demand might be estimated beforehand and used to allocate reserved parking for the Arena at both sites, has been considered. However this is not recommended for the following reasons:

- The laying on of the Park and Ride operation for specific events will be pre-planned and communicated as such to the attendees of these events on the web-site travel information and in ticket packs issued. However, a lot of people may not necessarily elect to pre-book P&R at the time of event ticket purchase, but may still subsequently decide to use it. As such, what may get notified may be no guarantee of the actual number of visitors turning up to use the service. If nobody pre-booked, it would still be necessary to run the extension service in view of the information given on the web-site/and to ticket holders for a said event;
- With respect to estimating the maximum pick-up demand which might have to be dealt with for given events, it is the case that this cannot exceed the capacity it is possible to provide in the arrival period. It has been assumed that visitors arriving for evening events will turn up over a three hour period beforehand (4:30-7:30pm). Taking Brislington as an example, the 12 minute frequency provides for 15 buses over this 3hr period with a maximum carry of 1,125 people. It is considered fairly unlikely that all people using the service over this time would be Arena visitors, but assuming 80% of them were then a good proxy would be about 900 maximum turning up for a return trip between 11:30pm-00:30am. This would be covered by a 12 bus pick-up operation as discussed; and
- There will, however, need to be some contingency in the operator agreement to deal with 'excess' demand turning up for the last bus (advance ticketing would not give any steer on this). Running the operation until 00:30am will hopefully ensure that the last bus is only dealing with stragglers, but this is no guarantee.

Consideration could be given to offering a discounted price ticket for Arena ticket holders when boarding, which would add incentive for Arena visitors to use the service. If separately logged on the ticket machine transactions it would be possible to download/review data post-event to determine how many Arena visitors had used the service and required pick-up, plus the revenue obtained. This historic log information, together with experience of operating the service over time, will help to tailor the size of the pick-up operation needed for particular size events over time and the contingency needed.

12.3.3 Late Night Rail Improvements/Special Event Provision

12.3.3.1 Bristol Parkway Shuttle

A positive letter of intent to provide improved late evening services to support the big Arena events has been received from the main Train Operating Company (TOC) GWR, although what the TOC is able to provide on a given evening for a specific event will depend on available train paths and, critically, what engineering possessions Network Rail have planned. Rail electrification is expected to lead to an improvement in the late evening services from Temple Meads on weekdays and Saturdays, but the extent is unknown and cannot be reasonably assumed in the Arena assessment at this time.

The offering/availability of a re-arranged bespoke service to Bristol Parkway with the TOC Special Event Team is considered a reasonable assumption, whilst discussions with Network Rail show that planned possessions affecting the line between Bristol Temple Meads and Bristol Parkway do not come into effect until 11:50pm on a weekday and 11:40pm on a Saturday. Electrification and 'four tracking' between Bristol Temple Meads and Bristol Parkway may further reduce the risk of a possession taking out all line capacity in the future. GWR has also confirmed that it moves empty trains up the line from Bristol Temple Meads to depot at Parkway around this time of night. The Arena catchment analysis has demonstrated that the highest proportion of car-borne visitors for all events are expected to route into the City Centre via the M32, so there is a clear need for some additional public transport mitigation to service this demand arriving from the north for big events. This cannot be met by the current Park and Ride sites operated by the City Council.

The new IEP trains will comprise 5 car (318 seat) and 9 car (630 seat) units, and notwithstanding the Arena, there would be an expectation that one or more of these trains would be moved to depot at night at Parkway, following normal termination of a last timetabled service at Bristol Temple Meads. Assuming two services (9 car) to Parkway are secured for an event through the Special Event Team at GWR (assume 11:30pm and 11:45pm departures), the capacity available would be 1,260 persons with no standing. This would have the potential to remove about a further 525 cars from the City Centre highway network by encouraging use of the parking available at Bristol Parkway, and use of rail to/from Bristol Temple Meads. The greater difficulties in arranging this through the TOC, and obtaining clearance from Network Rail, may inevitably limit doing this to the big 12,000 capacity evening events, so 18-20 occurrences per year.

12.3.3.2 A4 Portway Park and Ride Rail Platform and Link

This scheme is included in Bristol City Council's adopted Joint Local Transport Plan and the adopted Bristol Local Plan, so in this sense the Council is committed to its delivery. It has progressed to Network Rail's 'GRIP 2' development stage, and the Council are currently considering options to take this forward to GRIP 3 which will develop a preferred option in detail and inform the detailed design.

A Portway Park and Ride 'rail connection' to Bristol Temple Meads could be of significant benefit to the Arena in the future. It is envisaged this could be specifically promoted to target Arena visitors arriving via the M5 to the north and south, and the M4 from the West (Wales), from where a high proportion of the demand is expected. Benefits would include:

- Access to Portway is easier for visitors routing via the motorway network, and doing this will not potentially add to traffic in the North Fringe/Parkway area between 5:00-6:00pm when visitors for evening events are expected to arrive;
- It would also take traffic pressure off M4/M32 Junction 19 in the weekday PM peak; and
- In the event of a planned possession coinciding with and preventing late rail service provision for a large event, the Portway Park and Ride bus fleet could be employed to run the 'pick-up' operation as a back-up. The logistics of so doing would be similar to that described for the extended operation at

Brisington and Long Ashton. As noted there, the A4 Portway site is not intended to form part of this operation, but could be used to fulfil a similar bus replacement pick-up operation if for any reason late train provision is not possible.

A typical unit or carriage operating on this line has 72 seats, but with standing which could be considered a reasonable assumption on this journey due to its duration this might give a capacity of 100 passengers per unit. The proposed platform is required to facilitate a minimum 4 x 23.2 metre (class 153) carriages, so the potential maximum carry loading could be 400 passengers for a four unit train.

Discussion with Network Rail does, however, reveal that the track possessions affecting the line north of BTM will potentially limit this option more than running a 'Parkway Shuttle'. This is because any rail services provided will need to run to the Portway Park and Ride station and back, and also be clear of the line between BTM and Bristol Parkway before 11:50pm on a weekday and 11:40pm on a Saturday. This limited 'window' from around 11:20pm for a first potential service, coupled with the single track working on the Severn Beach line, will make it difficult to run the high capacity operation needed to deal with the peak in departures from a large Arena event. As such, the BTM-Parkway 'shuttle' would remain the most viable option given the current possessions regime at the current time. However, the possessions regime could change over time and will need to be monitored for further opportunities in reviewing and developing the Travel Plan and specific event management strategies.

Traffic Impact & Forecast Modelling - 'With Event Mitigation'

13.1 Introduction

This chapter presents the modelling results showing the expected Arena development traffic impacts on the highway network with additional 'event specific' mitigation measures in place. As specific Park and Ride, and potentially rail, interventions will be most important on a weekday evening to cater for large events, the modelling considers this only (12,000). As such the impact on a 6,000 average capacity event on a weekday evening and 6,000/12,000 events running on a Saturday evening are not assessed. This is because the 'worst case' modelling results suggest that satisfactory highway operation for these scenarios can be maintained.

However, as assessments show that parking in the City Centre will be most constrained during the visitor arrival period for a Saturday evening event, there would be sense in laying on the extended Park and Ride operation for a large event then as well. It would also be sensible to look to secure the extra Bristol Temple Meads-Bristol Parkway rail services in addition, in order to encourage remote visitor parking here on Saturdays.

13.2 Scenarios Tested

As noted in the chapter discussing event specific mitigation, there is a greater uncertainty concerning what late night rail enhancement it may be possible to put in place for a specific event because of Network Rail planned maintenance possessions. In contrast, the provision and operation of extended Park and Ride is wholly within Bristol City Council's power to put in place. In view of this the model tests with event specific mitigation consider two scenarios as follows:

- Extended Park and Ride operation in place, but 'special event' late night rail service enhancements not possible due to planned maintenance possessions; and
- Extended Park and Ride operations and enhanced rail services available.

13.3 Matrix Adjustments

The benefit of the two mitigation scenarios has been tested through reductions applied to the 12,000 event visitor trip matrix. Since some of these trips removed by these measures may never have entered the model area, the first stage of this exercise was to determine the number of Arena trips entering the model area. This was carried out through examination of trip origin, likely route and car parking destination location. For example, trips using the M32 and parking in St Phillips would not enter the model area since they most likely route via M32 Junction 3 and St Phillips Causeway. The results of this analysis are shown in Table 13.1.

Table 13.1: Estimation of Trip Reductions for Mitigation Scenarios

Route	No. Trips	Estimated % Entering	P&R Reduction	P&R and Rail Red.
A4 Bath Rd	393	74%	-118	-118
A37 Wells Rd	141	80%	-128	-128
Bedminster Parade	299	61%	-97	-97
Coronation Rd	574	46%	-74	-74
A38 Stokes Croft	230	83%	-	-146

Table 13.1: Estimation of Trip Reductions for Mitigation Scenarios

Route	No. Trips	Estimated % Entering	P&R Reduction	P&R and Rail Red.
M32	1547	94%	-	-165
A420 Old Market	186	90%	-	-157
Total	**3369**	**-**	**-417**	**-884**

The analysis carried out in Chapter 12 shows that the Park and Ride extended provision equates to a reduction of about 640 cars which would otherwise seek to drive into the City Centre and park. Using the 'worst case' mode shift for an evening event the expected volume of visitor car traffic is around 3,500 vehicles without Park and Ride being available. As such, a potential reduction of circa 18% is achievable with an extended Park and Ride using just these two sites. The rail enhancements would have the potential to remove about a further 525 cars from the City Centre highway network by encouraging use of the parking available at Bristol Parkway, and use of rail to/from Bristol Temple Meads.

The reductions from the Park and Ride and combined mitigation measures were evenly split between trips entering via routes that would benefit from these measures. Trip reductions associated with Park and Ride were therefore applied to trips entering via Bath Road, Wells Road, Bedminster Parade, and Coronation Road, with trip reductions associated with enhanced rail provision applied to trips entering via Bond Street, the M32 and Old Market Street. These reductions were factored down by the estimated percentage of vehicles entering the model area to provide final reductions applied to the Arena visitor matrices (see Table 13.1).

13.4 Model Outputs

This section provides a summary of the model outputs from S-Paramics for the 2021 12,000 capacity event mitigation scenarios. As with the worst case results, the outputs represent an average from 20 separate random seed runs. Checks on the variance in mean network delay from these runs confirms that 20 runs are sufficient to provide robust results. More detailed modelling outputs are presented in **Appendix M**.

13.4.1 Network Performance

Table 13.2 compares the network performance outputs from S-Paramics for the weekday evening (3:00-8:00pm) 12,000 capacity event mitigation scenarios. The results show that the Park and Ride measures on their own provide a significant improvement in network conditions reducing mean network delay by 80 seconds and increase mean network speeds by 1mph compared to the unmitigated 12,000 event. The combined Park and Ride and rail enhancements provide further improvements in modelled network conditions with mean delays only 35 seconds higher compared to the Reference Case.

Table 13.2: Network Performance Statistics 12,000 Event Mitigation,, Weekday Evening (3:00-8:00pm)

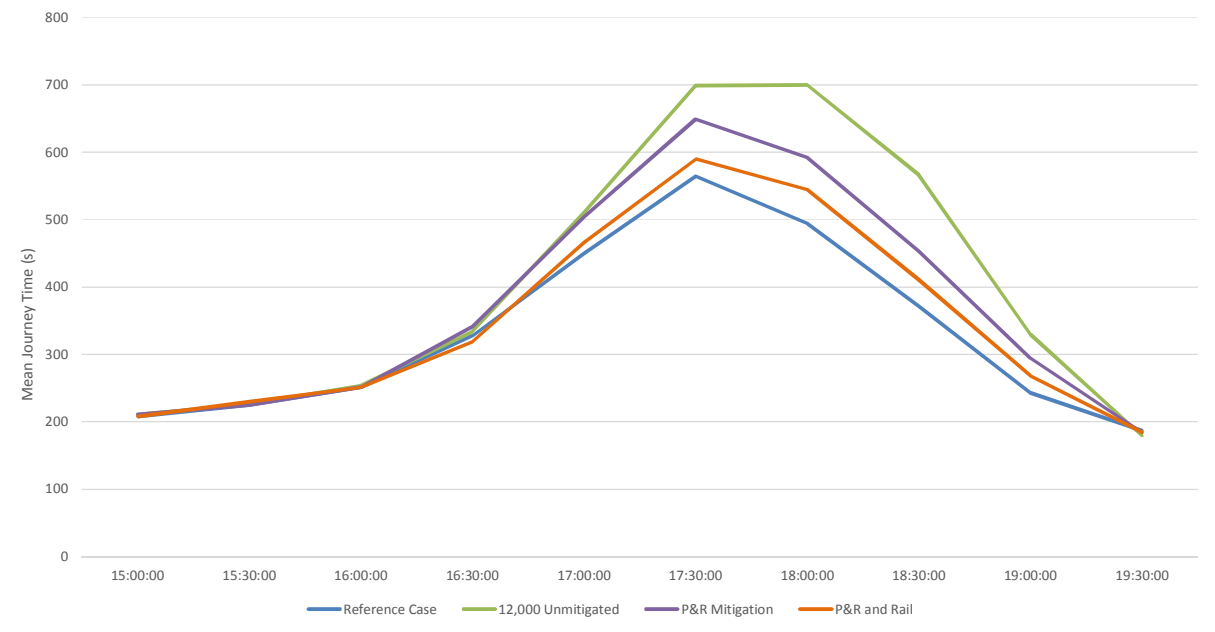
Network Variable	Reference Case	12000 Event	With P&R Mitigation	With P&R + Rail
Mean delay (s)	385	525	447	420
Total distance (km)	123,141	125,717	124928	124310
Vehs Entering Network	59,314	61,208	60942	60503
No. Vehs at 7:59pm	668	756	641	650
Journeys Completed	58,646	60,452	60301	59853

Table 13.2: Network Performance Statistics 12,000 Event Mitigation,, Weekday Evening (3:00-8:00pm)

Network Variable	Reference Case	12000 Event	With P&R Mitigation	With P&R + Rail
Network Demand	58,946	60,779	60520	60095
% Demand Satisfied	98.31%	98.33%	98.49%	98.45%
Mean Speed (mph)	12	9	10	11

Figure 13.1 compares the profile of network-wide mean journey times through the S-Paramics model network throughout the modelled period for the Reference Case, the 12,000 capacity event unmitigated, and the two mitigation scenarios. The graph shows that the Park and Ride measures improve mean journey times and shorten the peak conditions prevailing beyond the 5:00-6:00pm peak hour. The Park and Ride and rail measures combined are expected to yield network-wide journey times similar to the Reference Case, with a worst case increase of circa 40 seconds in the worst half hour between 5:30 and 6:00pm.

Figure 13.1: Network-Wide Mean Journey Times, Weekday Evening (3:00-8:00pm)



13.4.2 Traffic Flows

Table 13.3 shows the modelled traffic flows on the major routes entering the S-Paramics model area for the Reference Case and the change in traffic flows with a 12,000 capacity event plus the Park and Ride mitigation. The increases on most routes occur during the peak Arena arrival period between 6:00 and 7:00pm. However, the results also show a large in-flow on Bond Street between 7:00 and 8:00pm suggesting that congestion earlier in the simulation period is still preventing the in-flow of traffic on this entry link.

Table 13.3: Modelled Traffic Flow into Network, 12000 P&R Mitigation, Weekday Evening (4:00-8:00pm)

Route	Reference Case				P&R Mitigation (Traffic Change)			
	4-5pm	5-6pm	6-7pm	7-8pm	4-5pm	5-6pm	6-7pm	7-8pm
M32 Newfoundland Street	1807	1939	1626	1129	118	202	447	279
Houlton Street	91	96	80	64	13	9	28	44

Table 13.3: Modelled Traffic Flow into Network, 12000 P&R Mitigation, Weekday Evening (4:00-8:00pm)

Route	Reference Case				P&R Mitigation (Traffic Change)			
A420 Old Market Street	1249	1336	977	639	45	-27	91	29
A4 Bath Road	555	585	432	474	-12	-28	-25	-30
A37 Wells Road	663	694	523	561	7	-37	11	-18
St John's Lane	306	324	230	276	25	34	43	20
St Lukes Road	347	338	267	202	12	13	10	3
A38 Bedminster Parade	583	555	540	343	46	52	18	10
A370 Coronation Road	751	705	681	509	-64	-59	-61	-77
Commercial Road	823	783	664	496	-5	-16	-1	-8
Redcliffe Bridge	324	311	254	201	12	6	-2	5
Victoria Street	783	741	638	525	8	5	-3	-15
Lower Castle Street	580	538	493	348	5	-69	45	20
A4044 Bond Street	2543	2520	2304	1389	37	-170	-33	252
TOTAL ENTERING	**11405**	**11465**	**9708**	**7154**	**245**	**-85**	**567**	**515**

Table 13.4 provides the same comparison in traffic entering the S-Paramics model area by hour for a 12,000 maximum capacity event with the combined Park and Ride and rail mitigation. The results highlight that, with the combined mitigation, the in-flow profile of increased traffic across the four hours examined is much more consistent with the Arena event arrival profile. This suggests that the operation of the network under this scenario is no longer a constraint on traffic demand seeking to enter the simulation network.

Table 13.4: Modelled Traffic Flow into Network, 12000 P&R and Rail Mitigation, Weekday Evening (4:00-8:00pm)

Route	Reference Case				P&R and Rail (Traffic Change)			
	4-5pm	5-6pm	6-7pm	7-8pm	4-5pm	5-6pm	6-7pm	7-8pm
M32 Newfoundland Street	1807	1939	1626	1129	94	216	396	177
Houlton Street	91	96	80	64	13	9	28	44
A420 Old Market Street	1249	1336	977	639	26	-48	52	-10
A4 Bath Road	555	585	432	474	-12	-27	-26	-30
A37 Wells Road	663	694	523	561	7	-27	1	-18
St John's Lane	306	324	230	276	23	34	43	21
St Lukes Road	347	338	267	202	12	13	8	3
A38 Bedminster Parade	583	555	540	343	46	52	18	10
A370 Coronation Road	751	705	681	509	-66	-60	-67	-70
Commercial Road	823	783	664	496	-3	-18	-8	-3
Redcliffe Bridge	324	311	254	201	14	-2	1	7
Victoria Street	783	741	638	525	8	-11	-1	-2

Table 13.4: Modelled Traffic Flow into Network, 12000 P&R and Rail Mitigation, Weekday Evening (4:00-8:00pm)

Route	Reference Case				P&R and Rail (Traffic Change)			
Lower Castle Street	580	538	493	348	6	-59	43	11
A4044 Bond Street	2543	2520	2304	1389	26	-96	19	-9
TOTAL ENTERING	**11405**	**11465**	**9708**	**7154**	**193**	**-24**	**507**	**132**

Table 13.5 compares traffic held outside of the model at 6:00pm, 7:00pm and 8:00pm for the 2021 Reference Case and a 12,000 event with Park and Ride mitigation in place. The table still highlights a significant increase in unreleased traffic compared to the Reference Case on Bond Street. Whilst the volumes represent an improvement over a 12,000 event with no mitigation, the extent and continuation of the edge congestion through to 7:00pm is likely to result in operational issues within the City Centre highway network beyond the model extents.

Table 13.5: Unreleased Traffic Analysis, 12000 P&R Mitigation, Weekday Evening (6:00-8:00pm)

Route	Reference Case			P&R Mitigation		
	@ 6:00pm	@ 7:00pm	@ 8:00pm	@ 6:00pm	@ 7:00pm	@ 8:00pm
M32 Newfoundland Street	0	0	0	0	0	0
Houlton Street	0	0	0	30	7	7
A420 Old Market Street	42	0	0	94	0	0
A4 Bath Road	0	0	0	0	0	0
A37 Wells Road	3	0	0	17	0	0
St John's Lane	0	0	0	0	0	0
St Lukes Road	1	0	0	0	0	0
A38 Bedminster Parade	0	0	0	0	0	0
A370 Coronation Road	5	15	0	0	4	0
Commercial Road	0	0	0	1	0	0
Redcliffe Bridge	5	0	0	10	0	0
Victoria Street	5	1	0	4	0	0
Lower Castle Street	22	0	0	80	0	0
A4044 Bond Street	0	1	0	164	40	0

Table 13.6 provides the same analysis of unreleased traffic for a weekday evening 12000 maximum capacity Arena event with combined Park and Ride and rail mitigation. The results show a number of locations where vehicles are queued outside of the network during the 5:00-6:00pm peak hour. However, the net increase compared to the Reference Case is typically only around 50 vehicles. Whilst this will have some impact on the highway network outside of the modelled area, it should not be severe and the results show that all edge congestion is gone by 7:00pm.

Table 13.6: Unreleased Traffic Analysis, 12000 P&R and Rail Mitigation, Weekday Evening (6:00-8:00pm)

Route	2021 Reference Case			P&R and Rail Mitigation		
	@ 6:00pm	@ 7:00pm	@ 8:00pm	@ 6:00pm	@ 7:00pm	@ 8:00pm
M32 Newfoundland Street	0	0	0	0	0	0

Table 13.6: Unreleased Traffic Analysis, 12000 P&R and Rail Mitigation, Weekday Evening (6:00-8:00pm)

Route	2021 Reference Case			P&R and Rail Mitigation		
Houlton Street	0	0	0	30	7	7
A420 Old Market Street	42	0	0	80	0	0
A4 Bath Road	0	0	0	0	0	0
A37 Wells Road	3	0	0	10	0	0
St John's Lane	0	0	0	0	0	0
St Lukes Road	1	0	0	0	0	0
A38 Bedminster Parade	0	0	0	0	0	0
A370 Coronation Road	5	15	0	0	9	0
Commercial Road	0	0	0	0	3	0
Redcliffe Bridge	5	0	0	15	0	0
Victoria Street	5	1	0	16	0	0
Lower Castle Street	22	0	0	71	0	0
A4044 Bond Street	0	1	0	52	0	0

13.4.3 Route Journey Times

Figures 13.2 and 13.3 compare mean modelled journey times along selected representative routes through the model network for the weekday 5:00-6:00pm and 6:00-7:00pm hours, respectively. The routes examined are shown in Figure K1 in **Appendix K**, along with the detailed results in Table M1 in **Appendix M**. The graphs show that the Park and Ride measures (shown in grey) are effective in mitigating some of the expected increases in journey time along the routes examined from the 12,000 event (shown in orange), with the exception of the route from the M32 in both assessment hours.

The combined Park and Ride and rail measures (in yellow), as shown in Figures 13.2 and 13.3, provide similar reductions in the route journey times compared to the Reference Case (shown in blue), including on routes from the M32. Whilst the resulting journey times are not nil detriment, they represent modest increases over the Reference Case in most cases, with the most notable increase still evident on the A37 to M32 route. The resulting journey times between 6:00 and 7:00pm are also lower than between 5:00 and 6:00pm, suggesting an easing of peak period conditions.

Figure 13.2: Route Journey Time Comparison, Weekday Evening (5:00-6:00pm)

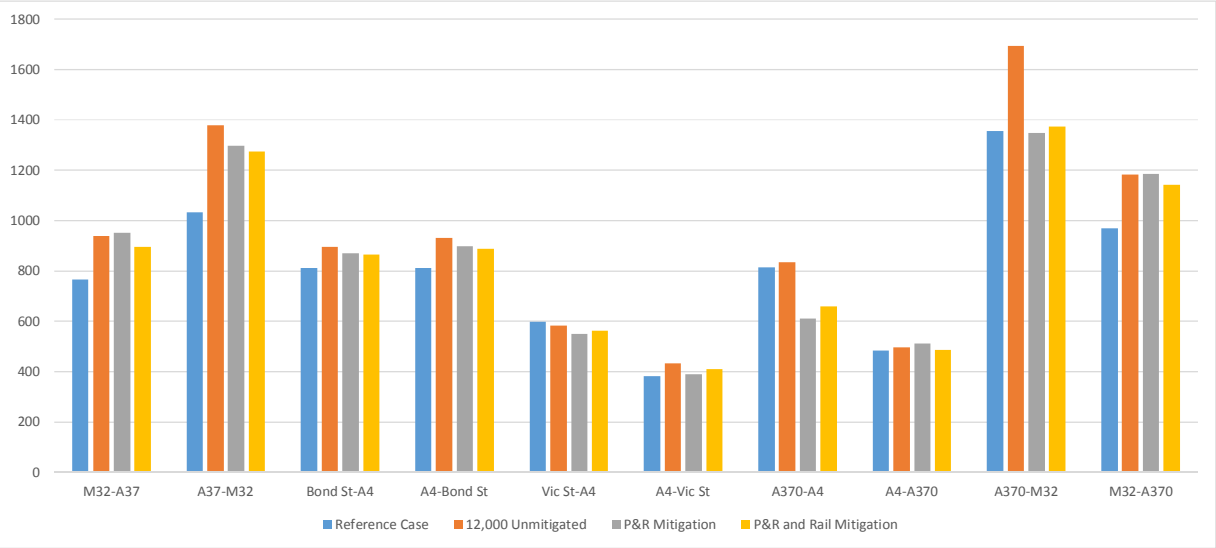
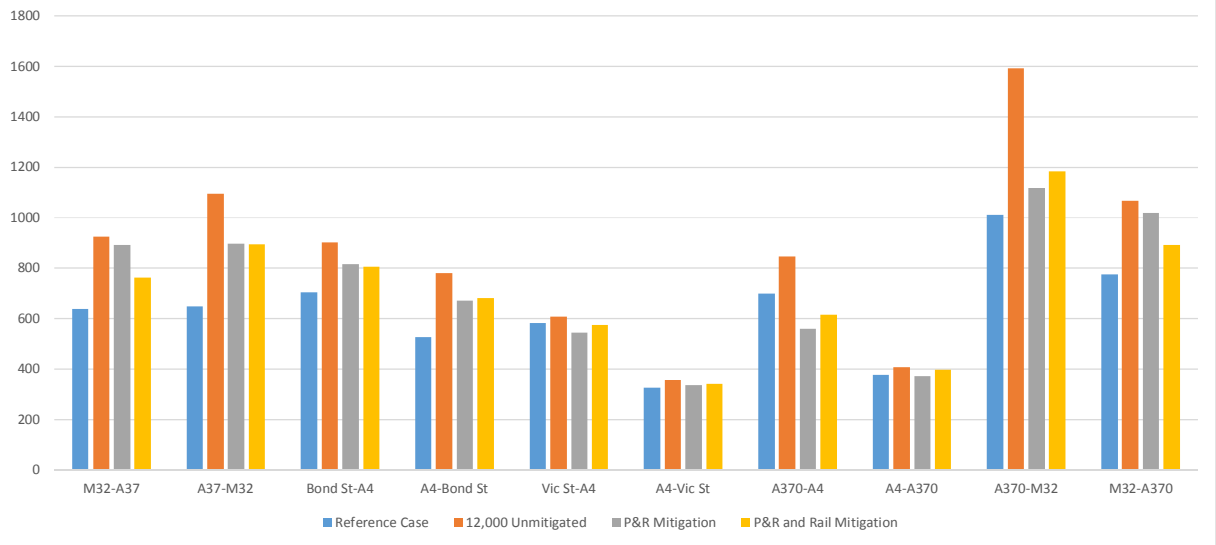


Figure 13.3: Route Journey Time Comparison, Weekday Evening (6:00-7:00pm)



13.4.4 Congestion Plots

Figures M1 and M2 in **Appendix M** compare the Reference Case and a 12,000 maximum capacity event with Park and Ride mitigation in place for the weekday 5:00-6:00pm and 6:00-7:00pm hours. The plots highlight that the measures have been effective in easing congestion along the New Cut but there is still increased congestion relative to the Reference Case on the M32, Wells Road and Bond Street during the 5:00-6:00pm peak hour, with evidence of highly congested conditions persisting on the M32 and Bond Street in the following 6:00-7:00pm assessment hour.

The Reference Case and a 12,000 event combining Park and Ride and rail mitigation are compared in Figures M3 and M4 in **Appendix M**. The plot highlights an easing of congestion on the M32 and Bond Street, which is evident in the unmitigated and the Park and Ride only scenarios. The plots show that residual increased congestion within the network is modest, with increases on Temple Way northbound and Counterslip. Furthermore, the degree of change in the bandwidths suggests that the increased congestion in these locations is not severe.

13.4.5 Intersection Analysis

Tables M2 and M3 in **Appendix M** compare intersection outputs for the Reference Case and a 12,000 event with Park Ride mitigation in place. Outputs for the 5:00-6:00pm and 6:00-7:00pm assessment hours are shown, and highlight the following:

- Impacts throughout the network are typically modest with typical increases in delays of less than 60 seconds and small increases in queue lengths, particularly during the 6:00-7:00pm assessment hour. However, there are some notable localised impacts noted below;
- Increased delays on a number of approaches to Cabot Circus gyratory with notable increases in delay of over 200 seconds on the M32 and Houlton Street approaches and over 60 seconds on Bond Street between 5:00-6:00pm. These relative increases become more pronounced as Reference Case delays abate between 6:00 and 7:00pm, with the event-related increase in delay on the M32 then rising to 300 seconds;
- An increase in delay on the Temple Way underpass approaching the Old Market slip-road signals of circa 70 seconds between 5:00-6:00pm, increasing to around 130 seconds compared to the Reference Case in the following 6:00-7:00pm; and
- An increase in delay on the A37 Wells Road approach to the A37 Wells Road/St John's Lane signals of circa 100 seconds compared to the Reference Case.

Tables M4 and M5 in **Appendix L** again compare junction outputs, but this time compare the Reference Case and a 12,000 event with Park Ride/rail mitigation in place. These results highlight the following:

- Generally modest impacts throughout most of the network, particularly during the 6:00-7:00pm assessment hour. However, some localised impacts still remain as identified below;
- A significant reduction in predicted delay at Cabot Circus gyratory compared to a scenario with no mitigation or just the introduction of extended Park and Ride. The increase in delay on the M32 represents an increase of circa 140 seconds in both hours over the Reference Case, with delays on Bond Street increasing by around 60 seconds between 6:00 and 7:00pm;
- As with the Park and Ride mitigation scenario, similar increases in delay on the Temple Way underpass approaching the Old Market slip-road signals persist This increase is circa 70 seconds between 5:00-6:00pm, but increases to around 130 seconds compared to the Reference Case in the following 6:00-7:00pm hour;
- Increases in delay on Redcliffe Street and Redcliffe Bridge of circa 70 and 90 seconds, respectively compared to the Reference Case; and
- The increase in delay on the A37 Wells Road approach to the A37 Wells Road/St John's Lane signals remains of the order of 100 seconds compared to the Reference Case.

13.5 Overview

This chapter has presented results from traffic modelling of two scenarios aimed at mitigating the adverse highway operating impacts of a 12,000 capacity arena event on a weekday evening. The assessment has considered two scenarios. The first assumed an extension of Park and Ride services operating from the Brislington and Long Ashton Park and Ride sites. The second scenario assumed the same Park and Ride measures as well as late service rail enhancements, enabling visitors to use Parkway Station as a Park and Ride facility.

S-Paramics modelling of these scenarios shows that the Park and Ride measures are effective in reducing much of the impact of the 12,000 capacity event. However, significant delays of up to 5 minutes could still result on Newfoundland Street/M32. The results also indicate significant queuing on Bond Street, with a high number of vehicles unable to enter the modelled highway network under consideration, persisting through to 7:00pm. This is likely to have implications for St James

Barton roundabout and the wider City Centre network. Whilst the modelling is highly robust in view of the background growth assumed, traffic generation and lack of any optimisation of signal timings, it does appear that the Park and Ride measures alone would not be sufficient to satisfactorily mitigate the impact of a weekday 12,000 capacity event.

However, the modelling of a weekday 12,000 capacity event with combined Park and Ride and late evening rail enhancements shows that predicted residual event delays on the M32 can be significantly reduced, whilst limiting the extent of edge congestion on Bond Street. Whilst the modelling still predicts some increases in cross-network journey times and localised junction delays, it is considered that these increases are within acceptable tolerances given the infrequent nature of such events and the fact that modelling of the 12,000 event assumes a 'sell out', which the Arena operator advises is rarely achieved in actual sales.

Construction Traffic

14.1 Routing and Access

Construction of the Arena will be contained within the Arena Island, with the construction site compound also positioned on the island itself. However, routing of construction traffic will have to be managed and a plan adhered to, in order to ensure that suitable access routes are used to minimise the external effect of heavy vehicle movements. It is not intended that the existing access to the site from the A4 Bath Road would be used in any way by construction traffic associated with the Arena. The new HCA Bridge access to Cattle Market Road would be sued as the sole vehicular access point for all construction traffic movements.

Appendix N shows the various constraints on the surrounding highway network that will serve to restrict or control the routes that can be used by heavy construction traffic during the build-out of the Arena Island site. The plan included in the appendix was formerly prepared and used to assess suitable routes for construction traffic accessing the wider TQEZ area, so it is equally applicable to consideration of the Arena Island which is a key site within it.

The routing plan shows that surrounding constraints imposed by low bridges in particular leave only two access routes as suitable for accommodating heavy vehicle construction traffic associated with the Arena. These are:

- From/to the Bristol Spine Road via Albert Road and the Feeder Road/Albert Road junction; and
- From/to Totterdown Bridge via Albert Road as above.

In both cases there is a bridge height constraint on Albert Road where the railway crosses it of 5.58m. On all other access routes into the TQEZ area other than Feeder Road, which was previously considered unsuitable, there are over-bridges with more restrictive height clearances.

Taking into account the two routes available the routing plan to be subsumed into a wider Construction Traffic Management Plan (CTMP) should ensure that all construction traffic from the north (via M32) is directed via the Bristol Spine Road to the Albert Road/St Phillips Causeway roundabout, and thereafter via Albert Road. Similarly, lorry movements to/from the A4 Bath Road should be signed via the same roundabout. The right turn from the A4 Bath Road to Totterdown Bridge is in any case prohibited, but the reverse route is possible so should be discouraged. Lorry moments to/from the A4 Portway, the A370 or A38 will most likely use the City Centre road network and access the TQEZ/Arena Island via Totterdown Bridge. However, it is intended that movements from/to the M5 (N) would be directed via the M32, and not encouraged to route via M5 Junction 18 and the A4 Portway.

14.2 Construction Traffic Management Plan

A Construction Traffic Management Plan would be used to control off-site routing, the effective distribution of materials throughout the site and the safe segregation of vehicles and pedestrians. Typical measures would include:

- Deliveries scheduled outside the main peak hours;
- Carefully managed, just-in-time delivery schedules to avoid congestion on the surrounding roads and on the site; and
- Wheel washing and road cleaning facilities.

At this point in time a contractor has not been appointed, so it is not possible to describe or comment upon the contractors intended phasing of construction, or indeed the likely number and type of heavy construction traffic movements expected on a typical daily basis during different phases. This will need to be covered in a detailed CTMP to be submitted post-application at the appropriate time.

Summary and Conclusions

15.1 Summary

15.1.1 Applications and TA Coverage

This Transport Assessment (TA) has described the analyses undertaken to assess the transport effects of a 12,000 capacity Arena situated on the Arena Island site next to Bristol Temple Meads railway station (Phase 1), and covered by the Detailed Planning Application submitted. In addition, it considers the subsequent impact of secondary development on the Arena Island (Phase 2), utilising land used for car parking in the first phase works. A second Outline Planning Application covers these other Arena island land uses which comprise, 19,158sqm commercial office development (B1 land use class), 3,408sqm to include restaurants, bars, convenience store and microbrewery (A3 / A1 land use classes); and 200 residential apartments (C3 land use class).

15.1.2 Accessibility

15.1.2.1 Existing

The Arena Island is located close to Temple Gate and, as noted above, adjacent to the main Bristol Temple Meads railway station. It is thus well situated next to an existing 'transport hub' with good accessibility by both bus and rail. For visitors choosing to come by car there are a range of central area off-street car parks within a 20 minute walk catchment of the site, which collectively give a supply of some 6,500 spaces. The Arena proposals do not include any intention to augment or increase the existing general supply of City Centre parking stock, other than the provision of disabled parking and limited concessionaire/ operational parking on the Island. Perhaps one of the biggest transport constraints is the drop-off in the existing late evening rail services operating out of Bristol Temple Meads, which unless improved will serve to restrict this choice of mode for many visitors attending events with a late evening finish from 10:30-11:00pm on a weekday or Saturday.

15.1.2.2 Committed Improvements

The transport accessibility to the area by walking, cycling, bus and rail will be greatly improved by a number of committed transport improvements as follows:

- Temple Gate improvements;
- Temple Greenways projects, including the HCA Bridge to Arena Island and the new Harbour Walkway;
- A new pedestrian footbridge link from Arena Island to Albert Road
- MetroBus; and
- MetroWest.

15.1.2.3 Arena Specific Transport Improvements

In addition to the above, the development of the site will include the provision of a new southern pedestrian/cyclist linkage from the proposed Arena Terrace to the A4/A37 Three Lamps junction, so bypassing the existing substandard footway along the east side of the A4 Bath Road where is crosses the two railway bridges. This will vastly improve walking/cycling connectively between Arena Island/wider TQEZ and the residential areas of Totterdown/Windmill Hill and Knowle to the south.

15.1.3 Assessment of Highway Impact

Data from the Leeds Arena TA, and source survey information within this relating to the MEN Arena in Manchester and the Nottingham Arena has been used to establish the likely 'worst case' visitor mode split, assuming no change to existing rail or bus operations to cater for specific events at a

Bristol venue. For evening events on a weekday or Saturday the derived mode split from these other Arenas gave a car occupant percentage of 80%, and a typical car occupancy of 2.4. For the largest events comprising 12,000 spectators, which are expected to occur about 20 times a year, the expected unmitigated car traffic generation would be circa 3,600 vehicles after making some allowance for trip linking (10%). For an average weekday or Saturday evening event of 6,000 attendees the expected traffic generation would be around 1,800. It is important to note that these arrivals would be expected to occur over a period of time before an anticipated 7:30pm start time for an event and, after discussion with BCC Transport Development Management (TDM), a three hour period and profiles were agreed.

From information provided by the Arena operator, a one hour drive-time catchment area around Arena Island was used, and the population distribution within this used to estimate the origin pattern of visitors attending a typical event at the Arena with a regional appeal. The existing GBATS model of the greater Bristol area was then used to determine the routing used by visitor traffic accessing the City Centre, and ancillary diversionary effects on existing traffic. For assessing the changes in expected highway conditions in the City Centre a detailed S-Paramics model covering an area agreed with TDM was developed and used. This was fully calibrated and validated for the weekday period from 3:00-8:00pm and the Saturday periods from 12:00noon to 3:00pm and 4:00-7:00pm.

These models were used to assess a number of Arena event scenarios in 2021, with effects compared with a Reference Case incorporating growth effects due to committed developments over this period. The next section describes the key findings from the model tests and conclusions in respect of necessary event mitigation to discourage the volume of car travel.

15.2 Conclusions

15.2.1 Weekday Evening

15.2.1.1 Highway Operation - Worst Case

The GBATS/S-Paramics models were used to consider 6,000 and 12,000 event scenarios with the worst case 80% car occupant mode shift assumed. The results from the S-Paramics model showed that the effect of a 6,000 event on a weekday evening would lead to some localised impacts during the 5:00-6:00pm peak hour, although these impacts would dissipate quickly once evening peak background traffic levels begin to abate. In overall terms, the average network delay for all journeys remained very similar to the base-line Reference Case throughout the 3:00-8:00pm period assessed. A wider assessment of visitor traffic routing in the GBATS model showed that, in the 5:00-6:00 peak hour, around 300 of the expected 540 (30%) arrivals overall in this hour would route into the City Centre via the M32 so, not unexpectedly, the localised impact would be most marked at the Cabot Circus gyratory and Old Market Street. Arrival demand in the peak hour elsewhere (240 vehicles) is spread across a number of approach routes so effects are dissipated.

The effects of a 12,000 maximum capacity event held on a weekday evening would, however, be expected to have a significant detrimental impact on the operation of the network modelled without some special event mitigation measures to discourage visitor car travel into the City Centre at this time. Results obtained predicted a notable worsening of conditions during the peak hour (5:00-6:00pm) with this congestion taking some time to abate. Examination of changes in traffic flows and queuing levels revealed extensive additional congestion on particular approaches to the modelled network under consideration, notably Newfoundland Way (M32) and Bond Street.

15.2.1.2 Parking

Parking occupancy surveys were undertaken at a number of City Centre off-street car parks within or just outside a 20 minute walk zone catchment of Arena Island in March/April 2015. This was supplemented by on-street parking surveys in the St Phillips area. Whilst there is currently opportunity for visitors to park in residential areas within this zone, specific consideration of capacity

here was not assessed as the need to deter this is accepted. The results showed that demand associated with a 6,000 event on a weekday evening could easily be accommodated by spare capacity available in the primary off-street car parks considered alone. This is because the existing occupancy of these car parks falls off quite noticeably between 5:00-7:00pm when most car borne visitors are expected to arrive in the City Centre.

As expected, a larger event occurring during a weekday evening will place much greater demand on car parking supply in the City Centre. Results suggest that parking demand generated by a maximum 12,000 capacity event could only just be accommodated by spare capacity in the primary City Centre car parks considered, but easily when all other parking is taken into account, including highly probable on-street parking in the St Phillips trading estate area close to Arena Island. It should be reiterated that this assumes a 'worst case' car occupant mode split of 80%, which the highway operation results show would have to be tackled and reduced for 12,000 events on a weekday evening. This mitigation would also serve to reduce the City Centre parking demand.

15.2.2 Saturday

15.2.2.1 Highway Operation - Worst Case

The GBATS/S-Paramics models were also used to consider 6,000 and 12,000 event scenarios occurring on a Saturday evening. In addition, a daytime Saturday scenario was considered looking at the change-over period between 12:00noon and 3:00pm with a morning event starting at 11:00am and finishing around 1:00pm, and an afternoon event starting at 3:00pm. The assessments have shown that, with lower levels of background traffic and congestion evident during a Saturday, the 6,000 matinee, and 6,000 and 12,000 maximum capacity evening events could be accommodated without significant detriment to the operation of the highway network assessed. The Saturday 6,000 matinee events, which would already benefit from higher public transport opportunities available to visitors during the day-time, were predicted to have some impact on network operation during the change-over period. However, in aggregate terms this impact is still predicted to be relatively minor, with modest localised increases in queuing and delay that are not considered to be severe.

15.2.2.2 Parking

The results show the full level of car parking demand associated with a 12,000 capacity event on a Saturday evening could only be accommodated when taking into account on-street car parking availability and usage in St Phillips. This is because the existing utility of the main car parks considered remains higher for a later period than the weekday. For the two Saturday 6,000 matinee events considered in the day-time, the surveyed surplus capacity in the main off-street car parks would just cope with the parking demand expected. So, whereas highway operation is not such a critical issue on a Saturday as a weekday evening, the available parking supply in the late afternoon during the expected arrival period for a 12,000 capacity event is more constrained at this time.

15.2.3 Mitigation

The mitigation needed to ensure both safe and convenient access to Arena Island and address wider transport impacts has identified permanent 'non-event specific' measures necessary and specific event management plan measures needed for specific events.

15.2.3.1 Permanent Measures

With regard to the former the following 'package' is proposed:

- A financial contribution towards parking controls which are likely to be necessary to deter visitor parking in the residential areas of Totterdown, Windmill Hill, Upper Knowle and The Dings, all of which lie within the 20 minute walk zone of Arena Island. Any such measures would be subject to consultation with residents in the affected areas;

- A financial contribution towards extending existing controls 'as necessary' in existing RPS areas affected. The RPS areas most likely to be affected are Redcliffe, Easton and St Phillips and Bedminster East;
- A new pedestrian/cycle linkage between Arena terrace and the A4/A37 Three Lamps junction to improve access to the A4 Bath Road and radically enhance accessibility/connectivity between Arena Island and residential areas to the south. There is an aspiration to extend this linkage through the Arena Island to improve accessibility to the wider TQEZ. This linkage would bypass the existing narrow footway along the east side of the A4 Bath Road between Three lamps and Bath Bridges, so serving to remove crowd loading impacts and conflict with existing heavy pedestrian/cyclist use of this footway in the weekday 4:30-6:30pm period in particular;
- Creation of a bespoke coach drop-off/pick up zone at the northern end of Albert Road. This would utilise Victoria Road which would be made one-way southbound. Improvements to crossing facilities at the Feeder Road/ Albert Road signalled junction are proposed to create safe pedestrian access between Victoria Road and Cattle Market Road;
- New and improved 'way-finding' signing to Arena Island, particularly on the City Centre routes from the main car parks; and
- A comprehensive travel information section on the Arena web-site on 'how to get there' with links to other information. The latter would include a Parking APP being developed by the City Council, and, as set out below, specific information on travel measures being put in place for specific events to discourage driving into the City Centre.

15.2.3.2 Event Specific Measures

A series of Event Management Plans (EMP) will need to be developed and put in place to bring into effect additional measures for certain events. A weekday 12,000 maximum capacity event is a case in point, as the modelling results show that the potential highway operating impacts of 80% of visitors travelling by car into the City Centre between 4:30-7:30pm will be severe if unmitigated. However, It is important to note that the 'detail' of these cannot necessarily be established at this stage, not least because the transport provision serving this area will inevitably change over the two year period before any opening of the Arena. The development and monitoring of Plans will need to involve the Arena operator, BCC and a wider stakeholder group involved in either running transport services or controlling network operation. This is expected and needs to include:

- The Arena operator: who would provide the list of events/timings/capacities for the forthcoming quarter;
- The operator's Travel Plan Coordinator (TPC);
- BCC - Arena Coordinator: a 'key' contact within the Council and, as advised by the operator, the approach adopted by other local authorities in the UK where they manage Arenas;
- BCC - Public Transport representative: Park and Ride;
- BCC - Network Management representative (Traffic Control Centre- Local VMS);
- Great Western Railway - Rail;
- Highways England - SRN Network Management (Strategic VMS Signing); and
- Police; and
- Traffic Management contractor (TTM).

As far as the critical components of these Plans are concerned it is concluded that mitigating the adverse highway operational effects of the large events will require an 'enhanced Public Transport options' approach. In other words, simply adding to parking stock will not deal with the traffic impact of visitors driving into the City Centre. Furthermore, the visitor traffic distribution will be

network wide, so targeting specific highway improvements in one or two locations will not deal with the potential congestion issue either.

In considering the potential to improve the public transport options available it is the evening events which are critical. This is because these will be the larger Arena events, and the time when existing bus/rail services are limited or non-existent in the late evening when these events finish at around 10:30-11:00pm. Whilst it is accepted that the delivery of both the MetroBus and MetroWest (rail) may serve to improve evening services available to Arena visitors over time, this assessment has examined the feasibility and likely effect of the following additional event-specific interventions:

- Extending Park and Ride operation at the Brislington and Long Ashton sites, and this 'option' to visitors, by using a bespoke pick-up operation between 11:30pm and 00:30am; and
- Running additional 'shuttle' trains between BTM and Bristol Parkway.

From discussions with BCC Public Transport and Great Western Railway (GWR)/Network Rail both options are considered feasible. Indeed, GWR have provided a positive letter of support to the concept of improving services to cater for the larger Arena events. The latter will be constrained by Network Rail track possessions, although the line between BTM and Parkway is not taken out of use until 11:50pm on a weekday and 11:40pm on a Saturday. The modelling results show that the introduction of these measures as part of a specific event Plan will be most critical in highway operating terms for a 12,000 event occurring on a weekday. However, City Centre parking availability in the late afternoon/early evening is more critical on a Saturday, so it is recommended that these interventions are also put in place for the large evening events happening then.

The effects of these enhanced public transport measures have been assessed for the weekday evening scenario with a 12,000 capacity event. Assuming 85% take-up of the Park and Ride capacity it would be possible to provide, and 2nr 'shuttle' trains operating to Bristol Parkway, the potential volume of City Centre bound visitor car traffic could be reduced by circa 1,170 vehicles. This is nearly a third of the 3,600 car trips expected if nothing is put in place. Examination of the residual network effects still shows some localised congestion impacts with an event of this size on a weekday evening. However, the following points need to be borne in mind:

- Maximum capacity events of 12,000 are only expected to occur up to 20 times a year, whilst a proportion of these may occur on a Saturday evening. As such, the additional congestion effects which may result on a weekday with such an event will be an infrequent occurrence;
- The analysis assumes that all seats are sold, which the operator confirms is rarely the case, even for a targeted 12,000 event; and
- The 'base-line' rail mode split proportion assumed is only 4% for both a weekday and a Saturday. Whilst it is accepted that the existing late evening rail services are quite constrained on a Saturday, it is possible to get back to a wider number of more distant destinations on a weekday.

In view of the results obtained 'with mitigation' it is considered that a severe impact on the highway network can be avoided with even the largest 12,000 events. However, it is considered that seeking to enhance public transport provision as part of a Plan or Plans to service specific events should not be limited to those of maximum capacity. This should be extended to cover all evening events of targeted >9,000 attendance to both reduce potential pressure on the highway network and City Centre parking demand.

Discouraging driving into the City Centre and use of other travel options on offer will require a strategy combination of delivering the relevant information effectively and, where possible, offering cost incentives. With respect to dissemination of information this will require:

- Clear information on travel options promoted on the Arena, with links to other relevant web sites; and
- All sustainable travel options, including specific measures put on for given events, would need to be included in literature distributed with tickets, including links to journey planners. Potential

congestion and parking difficulties at certain times of day, or the year ie Christmas, will need to be stressed as appropriate.

Ticket holder incentives to promote use of Park and Ride or rail are not within the Arena operator's power to provide, as the operator has no control over the ticket prices for a particular event. This lies with the promoter. Similarly, any 'offer' the Train Operating Companies may choose to run to attract Arena visitors is down to them. However, BCC could choose to promote the use of the extended Park and Ride service when put in place to cater for evening events by offering discounts to Arena visitors. The only potential issue with this will be the fact that the arrival journey will be via the normal service, so raising issues with other users paying a higher price for what they may perceive to be the same service.

15.2.4 Phase 2 Arena Island Developments

The outline planning application proposes 'other' land uses for the Arena Island site in Phase 2. This includes:

- 8,200sqm commercial office development (B1 land use class);
- 1,400sqm commercial A3 / A1 land use classes; and
- 9,400sqm of residential use (C3 land use class) - 80 flats.

The A1/A3 developments are intended to largely support the Arena venue and outside event times would be expected to generate a negligible amount of traffic, certainly in the weekday peak hours. The office and residential land uses will generate most vehicle traffic outside typical event times in the weekday peak hours, although as indicated above the residential component will be small in terms of the number of units.

TRICS analyses undertaken for 'City Centre' flats and commercial offices confirm that the biggest potential generator would be the offices with on-site parking uncontrolled. Without such controls the TRICS data shows that 8,200sqm of offices would be expected to generate around 50-60 two-way vehicle trips in the weekday 8:00-9:00am and 5:00-6:00pm peak hours. However, the daily profile shows that parking accumulation in excess of 85 vehicles would exist between 9:00am and 4:00pm. Highway Development Management advise that a fairly stringent maximum parking standard would be applied to any office development in the TQEZ, with I space/300sqm GFA advocated. This would provide 27 spaces for employees/operational use. Applying a proxy reduction to allow for this constrained parking would result in two-way office related flows of around 15 vehicles in the two weekday peak hours, whilst the residential generation would be small anyway. In view of this, the expected traffic impact of the Phase 2 developments on Cattle Market Road and the surrounding highway network is considered to be negligible.